співпраця з німеччиною
DEUTSCHE ZUSAMMENARBEIT

KFW

unicef
for every child



UKRAINE

DISTRICT HEATING STUDY

How to create a healthy economy for District Heating in Ukraine using Third Party Access

January 2026

Acknowledgements

The authors express their sincere gratitude to **UNICEF in Ukraine** and **Mr. Nicolas Osbert, Chief WASH**, as well as **Mr. Sergiy Sukhomlyn, Director of the Agency for Restoration**, for their support in achieving an up-to-date assessment of the economic challenges and opportunities in Ukraine's district heating sector. We also thank **Mr. Mykyta Kovalevskyi of the State Agency** for his support during visits to district heating companies.

We are especially grateful to the directors of the district heating enterprises for their cooperation and the exchange of valuable data and information: **Mr. Pavlo Karas (Director, Cherkasy Teplokomunenergo)**, **Mr. Oleksandr Chelnyk (Director, Kropyvnytskyi Teploenergetyk)**, **Mr. Volodymyr Faldyna (Director, Ivano-Frankivsk Teplokomunenergo)**, **Mr. Valery Ivanov (Director, Teplopostachannya of Odesa)**, and **Mr. Maksym Bilyk (Director, Vinnitsiamiskteploenergo)**.

Special thanks go to **Mr. Dmytro Rogozhyn, Director of Zhytomyrteplokomunenergo**, for providing an overview and detailed insights for the Zhytomyr district heating case study, to **Mr. Valentyn Hetman** for sharing the private investor's view and to **Ms. Mariia Druzhynina, Swiss Embassy's Project Representative**, for sharing a donor's perspective on successes and challenges.

We also thank **UNICEF Ukraine** and the **Ukrainian Association of Critical Infrastructure Operators** for co-leading a workshop as part of this study. Our appreciation extends to the participants and panelists, including **Kostyantyn Kovalchuk (Deputy Minister, Ministry of Development)**, **Ivan Lukeria (Deputy Head, Agency for Restoration)**, **Ruslan Holub (Executive Secretary, Association of Critical Infrastructure Operators)**, **Tamara Burenko (Danish Energy Agency)**, **Svitlana Chernykh (LCC Ukrpalet Energy)**, **Natalia Kravchenko (Director of Department, Ministry of Development)**, **Ruslan Ovcharenko (Director of Department, National Energy Regulation Commission NERC)**, **Pavlo Karas (Director, Cherkasy DHC)**, and **Winfried Damm (Director ReWarm Project, GIZ in Ukraine)** for their valuable contributions.

In addition, we acknowledge the **DEA (Danish Energy Agency)** for their foundational analytical work on long-term energy modeling and district heating development pathways for Ukraine, **DBDH (Danish Board of District Heating)** for providing technical expertise and European case studies demonstrating successful industrial surplus heat integration, and **GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit)** through the ReWarm Project for their contributions to Ukraine's district heating sector modernization and decarbonization efforts.

This research was produced with the financial support of the German Government through the German Government's Federal Ministry for Economic Cooperation and Development (BMZ) through the KfW Development Bank. Its contents are the sole responsibility of UNICEF and do not necessarily reflect the views of the German Government.

Cover photo: ©Mykyta Bosenko / UNICEF Ukraine

Authors

Serhiy Pinchuk (Regional Expert)

UNICEF Consultant

Serhiy Pinchuk has over 12 years of experience working in Ukraine's district heating sector from multiple perspectives, including with non-governmental organizations, government bodies, and as staff within donor structures. As an active participant in specialized professional associations, he brings comprehensive understanding of Ukraine's district heating landscape, regulatory environment, and reform challenges. His diverse experience positions him to bridge technical, policy, and institutional aspects of district heating modernization in the Ukrainian context.

Rasmus Aaen (International Expert)

Founder, Sustainable Utility

Rasmus Aaen brings over 23 years of experience in the district heating sector, spanning energy planning, infrastructure investments, construction management, and policy development. His international expertise includes more than 10 years working across Central European countries, including Poland, Romania, Germany, and Ukraine. As an expert evaluator for EU HORIZON and LIFE programmes and member of Aalborg University's 4th Generation District Heating Research Centre steering committee, he specializes in district heating decarbonization, renewable energy, surplus heat integration, and regulatory frameworks for energy sector transformation.

Mirjam Sick (Leader of Study)

UNICEF Technical Cell Coordinator

Mirjam Sick transitioned into the humanitarian sector in 2022, joining Swiss Humanitarian Aid and its Water, Sanitation and Hygiene (WASH) expert group. She brings over 25 years of experience from the energy industry, where she held various management positions in research, development, engineering, and project management across hydropower and electricity generation. She earned her PhD in Mechanical Engineering from the Technical University of Karlsruhe and her MBA from the State University of New York in collaboration with GSBA Zurich.

Volodymyr Kot and Basat Motawi (Authors Zhytomyr Case Study)

UNICEF WASH Officers

Executive Summary

The ongoing war has devastated Ukraine's heating and power infrastructure. Millions face severe energy shortages during winter months. Damaged heating systems force families including children to endure dangerous cold.

UNICEF commissioned this study for Ukraine's State Agency for Restoration and Development of Infrastructure. It addresses immediate heating needs and long-term sector development.

Industrial surplus heat is the fastest available alternative energy source as it already exists and requires only transmission infrastructure.

Therefore, this analysis examines pathways for integrating this heat into district heating networks to improve energy security, reduce carbon emissions, and mobilize private capital. The study synthesizes findings from the Danish Energy Agency, USAID, Green Deal Ukraine and more. It adds new evidence from five Ukrainian utilities and stakeholder consultations. Recommendations draw from proven EU practices consistent with Ukraine's integration commitments.

Current Sector Challenges: Ukraine's district heating sector serves approximately 40% of the population. It remains heavily dependent on natural gas, requires substantial government subsidies, and attracts minimal private investment. Engagement with utilities in Vinnytsia, Ivano-Frankivsk, Kropyvnytskyi, Odesa, and Cherkasy reveals systemic financial constraints. A Zhytomyr case study provides additional detail. Frozen residential tariffs in several cities cover only 60-70% of economically justified costs. State compensation debts exceed annual revenues. Investment programs remain chronically underfunded, with approved capital expenditures diverted to operational deficits or remaining unspent due to liquidity constraints.

These conditions create a vicious circle of underfunding that prevents modernization and private investment.

The utilities operate primarily with aging gas-fired boilers. Substantial surplus heat potential exists near district heating networks, comparable to other EU countries' industrial bases.

Surplus Heat Integration Opportunity: Conservative estimates suggest Ukrainian industrial processes currently release approximately 4,000-5,000 GWh of surplus heat annually. Heavy industry, food processing, chemical manufacturing, cement production, and data centers vent thermal energy to the atmosphere. This heat could be captured and integrated into district heating.

The available surplus heat could provide heating for about 500,000 apartments replacing up to 500 million m³ of natural gas.

Such integration reduces fossil fuel dependence, lowers consumer costs, and enhances system resilience. It also attracts private capital without requiring public investment in heat production assets.

However, Ukraine currently lacks regulatory frameworks enabling third-party heat supply. Complex licensing requirements, lack of incentives, uncertain heat uptake, and state-mandated price caps prevent cost recovery for infrastructure investments.

One barrier is particularly critical:

Potential private suppliers carry all investment risk without guaranteed heat purchase from utilities.

As a result, Ukraine has practically no operating surplus heat projects. Some utilities have begun preliminary mapping through dialogue with industrial partners. Several projects are in development. However, systematic waste heat assessments are absent from municipal heat planning.

Recommendations for Utilities: Seven recommendations focus on immediate actions district heating companies can take within existing constraints. Key actions include optimizing gas-fired generation efficiency, developing strategic modernization roadmaps, implementing two-rate tariff structures where legally permitted, and preparing technical requirements for third-party heat integration. The most accessible starting point requiring minimal investment and facing no regulatory barriers:

Systematic surplus heat mapping is low cost, can start immediately, and requires no regulatory changes.

This mapping provides the foundation for initiating bilateral negotiations with industrial partners and building viable business cases.

Policy Reform Framework: Seven priority policy recommendations address structural barriers to private investment and third-party heat supply. The seventh recommendation separating social protection from tariff regulation is particularly sensitive. Current tariff suppression undermines utility financial sustainability while failing to protect vulnerable households.

- First, establish transparent third-party access frameworks with statutory connection rights and heat purchase obligations when offered below utility production costs.
- Second, streamline permitting by exempting third-party suppliers from full heat production licensing when selling exclusively to licensed utilities.
- Third, mandate industrial waste heat potential assessment in all municipal heat supply schemes.
- Fourth, establish protected investment program funding through ring-fenced accounts preventing diversion to operational expenditures.
- Fifth, implement statutory two-rate tariff structures separating fixed infrastructure costs from variable fuel costs across all regulatory jurisdictions.
- Sixth, create unified national frameworks with local implementation and central oversight to reduce regulatory fragmentation.
- Seventh, separate social protection from district heating tariff regulation. Tariff regulation focuses exclusively on cost transparency, efficiency standards, and preventing monopolistic pricing. Vulnerable households receive protection through targeted government subsidies separate from tariff setting.

European countries use a wide range of approaches to consumer protection and support. For example Denmark provides direct lump-sum payments through its Heat Check program. The UK implements automatic bill discounts through its Warm Home Discount, achieving high enrollment

rates. Germany provides targeted reimbursement covering up to 100% of heating costs for qualifying households. Poland combines immediate bill support with comprehensive energy efficiency investments. All models follow one principle:

Utilities receive cost-reflective tariffs and government subsidies protect vulnerable households as two separate systems.

Implementation Pathways: The study provides seven utility recommendations and seven policy recommendations designed for simultaneous pursuit. Implementation timelines vary by complexity, enabling both immediate action and systematic long-term reform:

- Immediate Actions (0-6 months): Utilities can start surplus heat mapping and bilateral negotiations with industrial partners without regulatory approval. These foundational steps require minimal investment and face few regulatory barriers.
- Quick Policy Reforms (6-12 months): Administrative procedures can mandate waste heat assessments in Heat Supply Schemes and streamline licensing for third-party suppliers. Negotiated bilateral agreements offer the fastest pathway to integrate existing industrial surplus heat, enabling project deployment within this timeframe.
- Moderate Reforms (12-24 months): Legislative amendments establish third-party access frameworks and protected investment fund mechanisms. These create bankable conditions for private capital mobilization.
- Complex Structural Reforms (18-36 months): Comprehensive legislative changes implement two-rate tariff structures, unified national frameworks, and separation of social protection from tariff regulations. These address systemic barriers.
- Systematic Market Development (2-7 years): Competitive auction mechanisms require complete ecosystem development including digital platforms, multiple competing suppliers, and regulatory capacity. While offering long-term transparency benefits, immediate surplus heat capture proceeds through bilateral agreements.

Success means capturing Ukraine's estimated 4,000-5,000 GWh of available industrial surplus heat enough to heat 500,000 apartments and displace approximately 500 million m³ of natural gas annually.

Industrial facilities with surplus heat are often located 1-2 km from district heating networks. At these distances:

Building and operating a district heating pipeline receiving energy from an industry can cost as little as one-tenth of the lifetime cost to build and receive the same energy from a natural gas-fired boiler.

International experience demonstrates the scale possible. Aalborg's cement plant partnership delivers 1,500 TJ annually, heating 30,000 households while saving 150,000 tons CO_2. The CP Kelco-VEKS partnership supplies heat to 8,000 households. Strasbourg's port industrial network reached 120 GWh in 2025 with plans for 250 GWh, serving 100,000 housing equivalents across seven municipalities.

The following report provides detailed analysis, international case studies, and specific implementation guidance for each recommendation. It examines regulatory frameworks, commercial

agreement structures, technical methodologies, and economic analysis tools adapted to Ukrainian conditions. The report draws from proven European practice while addressing Ukraine's immediate energy security needs and long-term EU integration requirements.

Content

Introduction **11**
Project overview 12
Methodology 13
The workshop 14

Understanding the challenges **16**
Barriers to Surplus Heat Integration 16
Social policy as part of District Heating Tariff regulation 16
The Vicious Circle of Underfunding 20
Identifying Viable Pathways Despite Constraints 21

Zhytomyr case study **23**

Current situation of Ukrainian District Heating and Third-Party Heat Supply **24**
Vinnytsia District Heating Enterprise “Vinnytsiamiskteploenergo” 25
Ivano-Frankivsk District Heating Enterprise «Ivano-Frankivskteplokomunenergo» 29
Kropyvnytskyi District Heating Enterprise “Teploenergetyk” 32
Odesa District Heating Enterprise “Teplopostachannya mista Odesy” 35
Cherkasy District Heating Enterprise "Cherkasyteplokomunenergo" 39
Major technical characteristics of five studied Ukrainian DHCs 43
Conclusion 44
Impact of Market Gas Pricing on the District Heating Sector 46

Third Party Access in the form of Surplus Heating to District Heating **48**
What is Surplus/Waste Heat 48
The Surplus Heat Potential in Ukraine 50
Examples of Surplus Heat utilisation 51
How to utilise available Surplus Heating opportunities 55
Systematic Resource Mapping: The Foundation for Action 60

Consolidated Recommendations **64**
Recommendations for DISTRICT HEATING UTILITIES 64
Recommendations for POLICY MAKERS 66
Implementation of recommendation 75

Discussion **77**
The Baltic Competitive Auction Model 77
Bilateral Agreement Frameworks 79
Comparison of Heat Procurement Approaches 79
Outstanding Questions 81

Contact information **83**

Bibliography **83**

Appendix **83**

Glossary

Organizations and institutions

Abbreviation	Full Name (English)	Ukrainian
DEA	Danish Energy Agency	Данське енергетичне агентство
DBDH	Danish Board of District Heating	Данська рада централізованого теплопостачання
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit	Німецьке товариство міжнародного співробітництва
UNICEF	United Nations Children's Fund	Дитячий фонд ООН
USAID	United States Agency for International Development	Агентство США з міжнародного розвитку

Technical terms - district heating

Term/Abbreviation	Definition (English)	Ukrainian
AC	Absorption Chiller	Абсорбційний холодильник
CHP	Combined Heat and Power	Когенерація
DH	District Heating	Централізоване теплопостачання
DHC	District Heating Company	Теплопостачальна компанія
HP	Heat Pump	Тепловий насос
HE	Heat Exchanger	Теплообмінник
HVAC	Heating, Ventilation, and Air Conditioning	Опалення, вентиляція та кондиціонування
LTDH	Low-Temperature District Heating	Низькотемпературне централізоване теплопостачання
Surplus Heat	Waste heat from industrial processes available for district heating	Надлишкове тепло
Supply Temperature	Temperature of water leaving the heat production facility	Температура подачі
Return Temperature	Temperature of water returning from consumers	Температура зворотної мережі

Energy units

Unit	Full Name	Ukrainian	Conversion
kW	Kilowatt	Кіловат	1 kW = 1,000 W
MW	Megawatt	Мегават	1 MW = 1,000 kW
GW	Gigawatt	Гігават	1 GW = 1,000 MW
kWh	Kilowatt-hour	Кіловат-година	-
MWh	Megawatt-hour	Мегават-година	1 MWh = 1,000 kWh
GWh	Gigawatt-hour	Гігават-година	1 GWh = 1,000 MWh
TWh	Terawatt-hour	Терават-година	1 TWh = 1,000 GWh
GJ	Gigajoule	Гігаджоуль	1 GJ = 0.278 MWh
Gcal	Gigacalorie	Гігакалорія	1 Gcal = 1.163 MWh

Financial and economic terms

Abbreviation	Full Name (English)	Ukrainian
CAPEX	Capital Expenditure	Капітальні витрати
OPEX	Operational Expenditure	Операційні витрати
TOTEX	Total Expenditure (CAPEX + OPEX)	Загальні витрати
O&M	Operation and Maintenance	Експлуатація та обслуговування
PPA	Power Purchase Agreement	Договір купівлі-продажу електроенергії
UAH	Ukrainian Hryvnia	Українська гривня
EUR	Euro	Євро
USD	United States Dollar	Долар США

Regulatory and policy terms

Term/Abbreviation	Definition (English)	Ukrainian
Law 1818-IX	Law of Ukraine on Energy Efficiency	Закон України "Про енергетичну ефективність" № 1818-IX
Tariff	Regulated price for heat energy	Тариф
Offtake Agreement	Contract guaranteeing purchase of heat	Договір про відбір тепла
Green Tariff	Preferential tariff for renewable energy	Зелений тариф
NREAP	National Renewable Energy Action Plan	Національний план дій з відновлюваної енергетики

Environmental terms

Abbreviation	Full Name (English)	Ukrainian
CO_2	Carbon Dioxide	Вуглекислий газ
GHG	Greenhouse Gas	Парниковий газ
RE	Renewable Energy	Відновлювана енергія
RES	Renewable Energy Sources	Джерела відновлюваної енергії

List of tables and figures

Tables

Table 1: Assessment of the investment environment in Ukraine taking the known challenges into account. .. 21
Table 2: Technical characteristics of five studied Ukrainian DH companies 43
Table 3: Theoretical estimate of the waste heat potential in Ukraine 50
Table 4: Overview of social protection model exampels from across the EU 74
Table 5: Comparison of Heat Procurement Options 80

Figures

Figure 1: The scope of the project focus on heat production. 12
Figure 2: The visuous cicle of underfunding 20
Figure 3: Local budget subsidies to the DHC (thsd.UAH) 26
Figure 4: Financial indicators at the end of 2024 (thsd UAH) 27
Figure 5: Financial indicators at the end of 2024 (thsd UAH) 30
Figure 6: Financial indicators at the end of 2024 (thsd UAH) 33
Figure 7: Local budget subsidies to the DHC (thsd.UAH) 36
Figure 8: Financial indicators at the end of 2024 (thsd UAH) 37
Figure 9: Financial indicators at the end of 2024 (thsd UAH) 40
Figure 10: Investment Program Overview 41
Figure 11: The principle of surplus heat utilization. 48
Figure 12: Surplus heat is generally available at a wide range of temperatures 49
Figure 13: For over 30 years Aalborg Portland have provided surplus heat to Aalborg District Heating 51
Figure 14: In the autumn of 2023 operation started on a combined cooling and heating plant delivering both cooling and heating to IKEA and surplus heat to the Aalborg DH network. 53
Figure 15: Since 2023 Thyssenkrupp Steel has supplied waste steam to König-Brauerei brewery through infrastructure built and operated by the District Heating company E.ON 55
Figure 16: Example of a Surplus Heat agreement between CP Kelco and TVIS 57
Figure 17: Example of the agreed surplus heat pricing principle between CP Kelco and VEKS using the “substitution price calculation” as the driving factor. 59
Figure 18: Example of surplus heat source mapping from Aalborg in Denmark 61
Figure 19: A simplyfied TOTEX comparison of a new gas boiler and and DH transmissionline 62

Introduction

The ongoing war has devastated Ukraine's heating and power infrastructure, leaving millions facing severe energy shortages during winter months. Damaged heating systems force families including children to endure dangerous cold. UNICEF Ukraine, together with the Government of Ukraine, has led the emergency response in the water and district heating sector across three winters (2022-2025). This has been achieved by hosting the WASH cluster and directly supporting its TechCell in coordinating humanitarian interventions that ensure access to clean water, sanitation, and adequate heating. UNICEF Ukraine maintains a substantial portfolio of investments in water and district heating infrastructure, enabling children to live in healthy environments even during wartime winters. The adverse health effects of inadequate heating, particularly on children and vulnerable populations, are well documented. Sustainable heating infrastructure is therefore integral to UNICEF's child-centered mandate, which is why UNICEF commissioned this study and continues its strong commitment to this sector.

This study was commissioned by UNICEF on behalf of Ukraine's State Agency for Restoration and Development of Infrastructure to examine practical pathways for integrating industrial surplus heat into Ukraine's district heating networks, addressing urgent needs for energy security, carbon reduction, and private capital mobilization. The target audience includes Ukrainian energy sector stakeholders, policymakers, municipal district heating utilities, international donors, and reconstruction partners.

Ukraine's district heating sector faces a critical challenge: despite substantial heat demand from approximately 40% of the population, the sector remains heavily dependent on natural gas, requires systemic government subsidies to maintain operations, and attracts minimal private investment for modernization and fuel diversification.

Frozen residential tariffs in several cities cover only 60-70% of economically justified costs, creating state compensation debts that exceed annual revenues.

This trajectory is unsustainable, subsidies drain public finances needed for reconstruction, gas dependency exposes households to price volatility and supply disruptions, and aging infrastructure deteriorates without capital for renewal.

This study addresses these challenges by examining practical pathways for integrating industrial surplus heat into district heating networks. The analysis identifies regulatory and economic barriers preventing private capital mobilization, proposes specific policy reforms aligned with EU Energy Efficiency Directive requirements and Ukraine's Green Deal commitments, and provides actionable implementation guidance for both utilities and policymakers.

The work emphasizes proposals that can be adopted early and implemented under current conditions, prioritizing reforms that enable near-term private investment while supporting longer-term sector transformation toward energy security, reduced carbon emissions, and financial sustainability through proven international models adapted to Ukrainian realities.

Project overview

This study concentrates on the production side of Ukraine's district heating value chain-heat generation and integration of alternative heat sources into existing networks. This deliberate focus responds to central government priorities for interventions that can deliver measurable results under current war conditions. Production-side improvements offer faster implementation than comprehensive network upgrades, with industrial surplus heat integration representing particularly achievable quick wins where thermal energy currently released to the atmosphere can be captured and utilized.

While the sector faces challenges across the entire value chain from production through distribution to consumption, private investment opportunities are more readily accessible on the production side. Project structures can be more modular and capital requirements lower, whereas network infrastructure and end-user installation improvements require more comprehensive legislative frameworks and are less suited for near-term private investment.

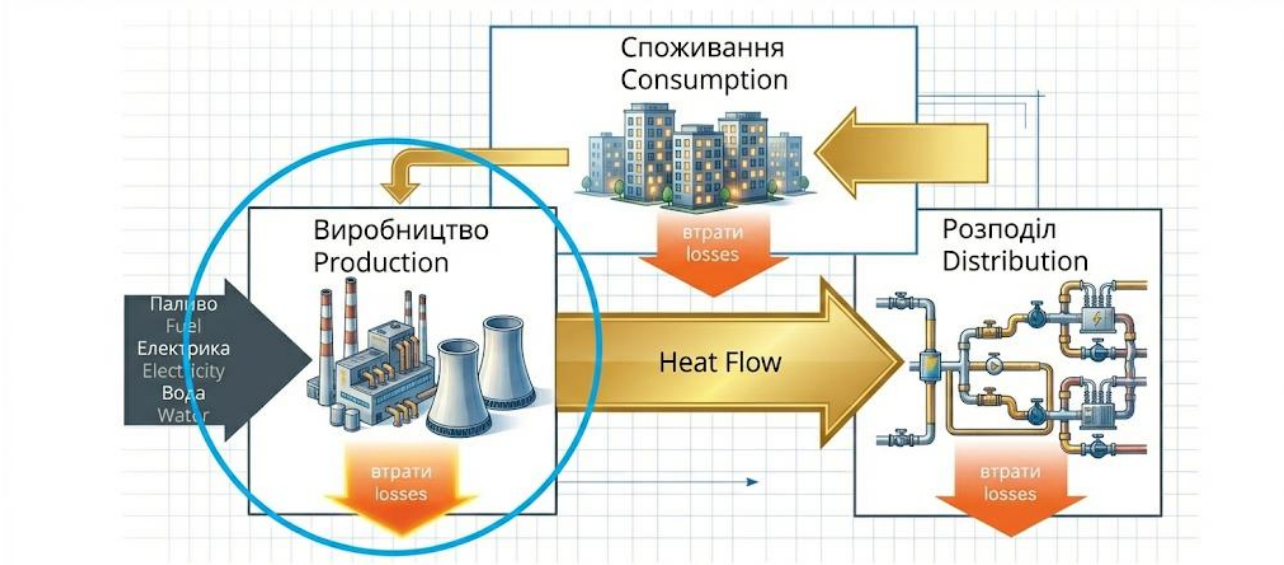


Figure 1: The scope of the project focuses on heat production.

The study's primary focus is surplus and waste heat from existing industrial sources; thermal energy currently released to the atmosphere that could be captured and integrated into district heating networks. The analysis also addresses biomass boilers, combined heat and power (CHP) plants, waste-to-energy CHP facilities, and renewable energy source (RES)-fired heat pumps, though these technologies receive secondary emphasis.

Geographic coverage includes direct engagement with district heating utilities in Vinnytsia, Ivano-Frankivsk, Odesa, Kropvynytskyi and Cherkasy, with Zhytomyr serving as an extended case study. The analysis operates within a fundamental economic requirement:

For third-party energy supply to succeed, it must offer better value than state-defined price alternatives.

This principle shapes the study's practical recommendations for both utilities seeking to diversify their heat supply and policymakers developing enabling regulatory frameworks.

The work integrates with ongoing Ukrainian legislative development processes and EU accession requirements, providing actionable implementation guidance rather than purely theoretical analysis.

Methodology

The study employs four complementary methodological approaches to develop practical, evidence-based recommendations for Ukraine's district heating sector.

Stakeholder Engagement: Direct interviews were conducted with representatives from five major Ukrainian district heating enterprises (Vinnytsia, Ivano-Frankivsk, Kropyvnytskyi, Odesa, and Cherkasy) to understand current operational realities, financial constraints, and technical capabilities. Additional consultations involved Ukraine's Ministry for Development of Communities and Territories, the National Energy and Utilities Regulatory Commission (NEURC), and industry representatives. International advisors including the Danish Energy Agency (EDA), the Deutsche Gesellschaft für International Zusammenarbeit (GIZ), and the Danish Board of District Heating (DBDH) provided technical expertise and comparative perspectives from mature district heating markets. This engagement ensured recommendations reflect actual implementation conditions rather than theoretical possibilities.

International Best Practice Analysis: The study examines proven surplus heat integration models from European markets, with particular focus on Danish bilateral agreement frameworks between industrial heat suppliers and district heating utilities. Case studies analyzing how mature regulatory frameworks enable successful third-party heat supply while maintaining system reliability and economic viability for all parties.

State-of-the-Art Studies Review: Rather than duplicating existing analytical work, this study synthesizes findings from four recent major assessments:

- the Danish Energy Agency's technical support reports for Ukraine (2024), which provide detailed EU Energy Efficiency Directive compliance guidance.
- the USAID Energy Security Project White Paper (2020), which established the foundational diagnosis of Ukraine's district heating challenges.
- Green Deal Ukraine's District Heating Status Report (2025), which updates earlier analyses to account for wartime infrastructure damage and reconstruction priorities.
- and the Agency for Renewable Energy's analysis of waste heat and geothermal potential for district heating in Ukraine (Kramar & Oliynyk, 2022), which quantifies industrial surplus heat availability by sector and region. This approach builds on substantial existing knowledge to focus on implementation gaps.

Technical and Economic Analysis: The study quantifies Ukraine's surplus heat potential by industrial sector using data from the Kramar & Oliynyk (2022) analysis and updated utility-level information. TOTEX (Total Cost of Ownership) methodology provides economic viability assessment, comparing surplus heat integration costs against gas boiler alternatives over project lifespans. Regulatory gap analysis examines Ukrainian legislation, particularly Law on Energy Efficiency No. 1818-IX, identifying specific inconsistencies with EU frameworks. Tariff structure analysis demonstrates how current single-tier pricing prevents cost recovery for infrastructure investments required to integrate third-party heat supply.

This methodology emphasizes practical implementation guidance for utilities and policymakers, synthesizing international experience and Ukrainian context to identify reforms that can attract private investment while maintaining system reliability and affordability.

The workshop

On December 16, 2025, UNICEF in cooperation with the Agency for Restoration, and the Association of Critical Infrastructure Operators of Ukraine conducted a Workshop “How to create a healthy economy for district heating in Ukraine? Can third-party access be used to end the government practice of setting fixed prices for gas and electricity?”

The Workshop was conducted in Kyiv in mixed format; over 30 people participated in person, with around the same number of participants joined online.

The participants of the event will include representatives from the Ministry for Communities and Territories Development of Ukraine, the National Commission for State Regulation of Energy and Public Utilities (NERC), directors of heat supply companies, representatives of private investors in DH systems, international donors and organizations.

The study on achieving economic sustainability for DH enterprises by increasing public-private partnerships and decreasing dependency on natural gas, which UNICEF had conducted in cooperation with the Agency for Restoration was presented during the Workshop. Additionally, issues related to the further development of DH systems in Ukraine and the possibility of attracting private investments in the DH sector were discussed.

Short summary of the Panel Discussion

“How to enable private investment in Ukrainian district heating and increase use of alternative energy sources”

The primary obstacles to attracting private capital into the Ukrainian heat supply sector are financial instability and a lack of predictability. Panelists emphasized that investors will not enter the district heating (DH) sector if economically unjustified tariffs and legislative moratoria on their increase remain in place. For businesses, it is critically important to understand the investment return mechanism through stable long-term income (over a 10–15-year horizon), guaranteed network access, and capital protection. Currently, most funds from District Heating Companies (DHCs) are directed toward settling gas debts rather than development.

Discussion participants noted that resolving the crisis is only possible through comprehensive liberalization of market regulation and a change in the management paradigm. Proposed measures include implementing incentive-based tariff regulation, unbundling (separating network management from energy production), and developing public-private partnerships. Specifically, the possibility of a gradual transition to market prices was discussed, starting with public sector, where the use of alternative energy sources can already be economically viable.

Special attention was given to infrastructure modernization within the “Build Back Better” framework. Since private capital is reluctant to invest in the renovation of obsolete heating networks due to excessively long payback periods, this area must become a priority for state programs and the attraction of low-interest credit from international financial institutions, such as the EBRD. Furthermore, the need to implement energy-efficient technologies, cogeneration, and the transition to targeted subsidies for the population - instead of general gas price subsidies – was highlighted.

The general conclusion of the panel is that the transition to market gas prices is an inevitable step that will stimulate efficiency and development. However, simply increasing prices without simultaneously addressing DH system energy efficiency, reforming municipal heat supply enterprises, implementing thermal modernization of buildings, and providing targeted protection for vulnerable consumers could lead to negative consequences for the district heating systems.

Short summary of the Panel Discussion

“How to improve the possibilities for DH companies’ modernization under current circumstances”.

The discussion participants focused on the lack of practice in Ukraine regarding the utilization of industrial waste heat in district heating (DH) systems and the low level of private investment in thermal energy generation.

The primary obstacle for private investors is current legislation, which requires any industrial facility wishing to sell heat to obtain a generation license and have a tariff approved. This creates an excessive administrative and financial burden, making it easier for enterprises to “release heat into the ai” rather than investing in networks and reporting to the regulator.

In addition to bureaucratic barriers, significant technical challenges exist. Most available waste heat is low-grade (low-temperature), necessitating the installation of thermal energy storage due to the uneven nature of industrial processes. Experts suggested considering the implementation of a “Heat Code” to clearly regulate technical connection conditions, coolant parameter control, and the distribution of powers between the Ministry and the Energy Regulator.

Participants view the transition from a system of “manual” management and individual ad-hoc agreements to transparent market mechanisms as a key solution for attracting private investment. It is proposed to introduce reverse auctions for heat procurement, where the starting price would be the production cost of the district heating company itself. Furthermore, it is important to unbundle the tariff into a variable component (energy cost) and a fixed component (capacity reserve payment); this would allow for infrastructure maintenance even when procurement volumes from third-party suppliers fluctuate.

Representatives from the regulator and ministry confirmed readiness for change, noting licensing simplification during martial law. However, piecemeal adjustments are insufficient. Sector recovery requires adopting European oversight models and comprehensive regulatory reform.

The participants stated that despite the enormous potential, third-party access and waste heat resources remain virtually unused due to excessive bureaucracy (licensing, complex tariff setting) and technical risks, such as inconsistent industrial heat supply and the difficulty of maintaining required temperature regimes. Key proposals included:

- Implementation of capacity reserve payments for district heating companies that integrate third parties and waste heat into their networks.
- The launch of heat auctions, enabling heat producers to compete on price for network access.

This will facilitate a reduction in the final tariff for consumers and enhance the sector's attractiveness to investors.

Understanding the challenges

Ukraine's district heating sector faces severe challenges. Ongoing attacks have destroyed power generation and severed networks, leaving millions without reliable winter heating. Children and families endure dangerous cold. The state budget no longer covers residential heat subsidies, while frozen tariffs prevent cost recovery and fuel prices climb. Utilities accumulate debt they cannot service, and investment programs remain unfunded. This study focuses on the limited pathways that remain viable under current conditions.

Barriers to Surplus Heat Integration

Three policy-driven barriers have effectively blocked surplus heat utilization despite Ukraine's significant industrial waste heat potential.

- **First**, frozen residential heating tariffs combined with price caps on privately supplied heat create an impossible commercial equation where only opportunities priced substantially below utilities' current gas-based production costs can be considered, eliminating nearly all viable projects. When utilities themselves are losing money on every gigajoule of heat sold, new suppliers face price points that cannot support even minimal returns on investment.
- **Second**, financially distressed utilities cannot invest in the connection infrastructure and network reinforcements required to integrate third-party heat sources. This transfers the entire capital burden and associated risks to private investors, who must finance not only heat production facilities but also the utility-side infrastructure needed to receive their output. In effect, private entities are asked to invest in both sides of the connection while bearing all performance and payment risk.
- **Third**, Ukraine's regulatory framework leaves two critical gaps that amplify investment risk: utilities face no obligation to utilize available third-party heat supplies, and private investors receive no guaranteed offtake volumes or duration. This means economically sound projects can be declined at utility discretion, while private entities bear full exposure to the risk that actual heat purchases will be insufficient to recover their connection infrastructure investments.

The combined effect is that surplus heat utilization remains virtually non-existent in Ukraine, despite available industrial waste heat potential, a rough estimate at 4-5 TWh, that if exployedable could replace gas consumption from more than 500.000 apartment[1].

Social policy as part of District Heating Tariff regulation

The current system uses tariff suppression as an indirect social support mechanism, but this approach simultaneously undermines service quality and utility financial sustainability as the tariff ceilings prevent utilities from recovering actual costs of heat production and distribution.

Tariff regulation should focus exclusively on cost transparency, efficiency, and preventing monopolistic pricing. Social protection for vulnerable households can be administered through targeted government subsidy programs that cover the difference between actual heating bills and what households can afford to pay.

[1] **The Surplus Heat Potential in Ukraine**

Here are some examples of how social policy and district heating tariffs are decoupled in other European countries.

Lump-Sum Payments

One-time or periodic fixed cash payments to vulnerable households

How it works: Government identifies eligible households and transfers fixed amount directly to them, which they can use for any household expenses including heating.

Countries & Programs:

- Denmark: “Heat Check” (Varmechecken) – €806/40,300 UAH per household
- Austria: “Climate Bonus” (Klimabonus) – fixed amount to all citizens
- Cyprus: Income and household size-based lump sum payments
- Poland: “Energy Allowance” (Dodatek Energetyczny) – €212-635/10,600-31,750 UAH one-off payment

Advantages: Simple administration, household flexibility, no utility involvement Disadvantages: Fixed amount may not match actual heating costs, potential for misuse

Heat Bill Coverage

Government subsidies covering actual heating costs, either before or after payment

Before Payment (Utility Side – Bill Discount)

How it works: Energy provider reduces bill amount at source; government compensates utility or regulates social tariff.

Countries & Programs:

- United Kingdom: “Warm Home Discount” – €175/8,750 UAH automatic discount with data-driven targeting (recommended increase to 70% of energy costs)
- Belgium: Extended Social Energy Tariff – special reduced rate for 16% of households
- Netherlands: Tax discount reducing energy bill amount
- Spain: Discounts on energy bills for vulnerable consumers

Advantages: Seamless for households, automatic enrollment possible, high take-up rate Disadvantages: Requires utility cooperation, complex compensation mechanisms.

After Payment (Consumer Side - Reimbursement)

How it works: Household pays full cost-reflective tariff to utility; government reimburses percentage or full amount based on actual costs.

Countries & Programs:

- Germany: Targeted Heating Assistance – up to 100% reimbursement for vulnerable households
- Romania: “Home Heating Aid” (Ajutorul pentru Încălzirea Locuinței) – percentage of actual costs reimbursed
- France: Crisis support with benefit increases tied to actual energy expenditures

Advantages: Utilities receive full tariff (investment-friendly), transparent cost-reflective pricing, clear separation of regulation and social policy Disadvantages: Requires households to have cash flow to pay bills first, more administrative steps.

Welfare Program Extension

Energy poverty treated as component of general social assistance.

How it works: No separate energy subsidy program; vulnerable households receive increased general welfare benefits sufficient to cover all basic needs including heating.

Countries & Programs:

- Sweden: General social assistance including energy costs as part of basic needs
- Denmark: Income assistance system addresses energy poverty within overall support framework (income threshold: €87,400/4,370,000 UAH annually)
- Netherlands: Municipal Debt Assistance Act with integrated energy support
- Germany: Energy poverty addressed primarily through general social protection system

Advantages: Integrated approach, avoids stigma of separate program, administrative simplicity
Disadvantages: May not be sufficiently responsive to energy price fluctuations, less visible support

Combined Programs

Integration of energy efficiency investments with heating cost coverage

How it works: Programs provide both immediate financial relief for heating bills AND investment in long-term energy efficiency improvements (insulation, heating system replacement, district heating connection).

Supplier Obligation Schemes

Countries & Programs:

- France: LTECV Program – energy suppliers obligated to invest €2 billion/100 billion UAH in fuel poverty prevention
- Ireland: “Energy Efficiency Obligation Scheme” (EEOS) + “Better Energy Warmer Homes Scheme”
- Spain: Energy efficiency obligations targeting vulnerable consumers

Municipal/State Grant Programs

Countries & Programs:

- Poland: “Stop Smog Programme” – up to 100% financing for heating replacement + DH connection + insulation (€265 million/13.25 billion UAH total budget)
- Slovakia: State Housing Development Fund – grants for thermal insulation + heating improvements
- Ireland: Multiple integrated programs (Better Energy Communities, Local Authority Housing Upgrade, Housing Assistance for Older People)

Advantages: Addresses root causes, reduces long-term subsidy needs, improves housing stock
Disadvantages: Complex administration, requires upfront capital, longer implementation timeline

Tool (Not Model): Emergency Crisis Support

Temporary measures during acute energy price crises

How it works: Time-limited interventions during energy price shocks, typically combining multiple tools: VAT reductions, universal payments, temporary benefit increases, extended eligibility criteria.

Examples:

- France: 4% emergency benefit increase + €230 million/11.5 billion UAH wood heating subsidy + rent controls
- Germany: €3.3 billion/165 billion UAH EEG surcharge reduction during 2022 crisis
- Belgium: €1.3 billion/65 billion UAH package – €100 / 5,000 UAH universal cheque + €200/10,000 UAH oil heating payment + VAT reduction + extended social tariff (€600 million/30 billion UAH cost for extended social tariff)
- Denmark: Expanded Heat Check during crisis + additional senior citizen payments of €672/33,600 UAH; additional €13.4 million/670 million UAH for municipal expenses

Overall

European countries do not rely on single models. Denmark combines lump-sum Heat Checks with welfare-integrated support; France pairs supplier obligations with emergency measures; Poland implements both energy allowances and comprehensive renovation programs.

These national models increasingly leverage EU-level funding mechanisms. The Social Climate Fund (launching 2027) and ETS2 carbon revenues provide substantial resources for vulnerable household support. Germany, France, and Poland are already designing integrated financing packages that combine national programs with EU climate funding. The core principle across all models:

Cost-reflective tariffs enable utility sustainability and private investment; targeted social subsidies protect vulnerable households

The Vicious Circle of Underfunding

These barriers are symptoms of a systemic trap that perpetuates sector decline.

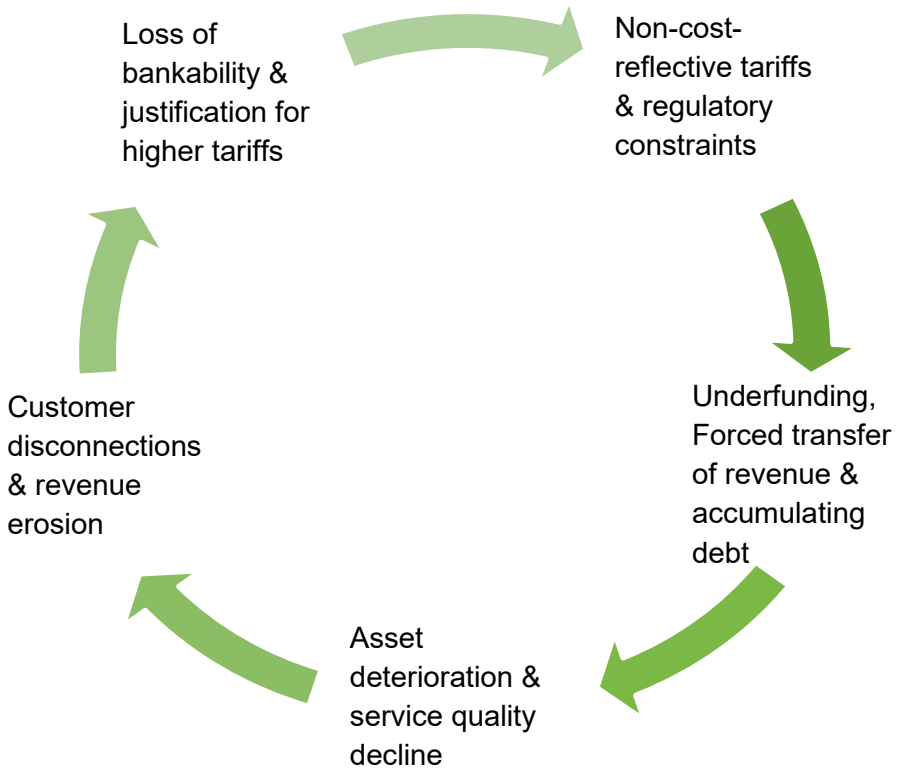


Figure 2: The vicious circle of underfunding

Frozen tariffs prevent cost recovery, forcing utilities to operate at losses while their physical assets deteriorate. This erosion of service quality and growing debt further undermines political will to raise tariffs, deepening the underfunding. Utilities respond by disconnecting customers and reducing service hours, both of which shrink revenue while fixed costs remain, worsening the financial position further.

The result is accelerating financial deterioration that makes any new investment, including third-party heat integration, virtually impossible. The sector is trapped in a self-reinforcing decline where the very policies meant to protect consumers are destroying the infrastructure that serves them.

Viewing Ukraine's district heating sector through an investor's lens reveals why private capital remains absent.

Based on documented sector conditions, the assessment is stark: five of seven key investment factors represent critical barriers (red), with the remaining two showing significant concerns (yellow). Even strong underlying heat demand cannot overcome the combination of frozen tariffs, capped heat purchase prices that eliminate returns, fragmented regulatory authority, deteriorating infrastructure reliability, and ongoing security risks.

These are not disputed conditions – frozen tariffs since 2020, substantial utility debt, and regulatory gaps regarding third-party access are established facts. What the assessment reveals is how these known realities compound to systematically eliminate the conditions necessary for private

investment. Any investment strategy must acknowledge this landscape rather than assume market-based solutions will emerge.

Market & Demand Strong demand but market distorted by gas subsidies	Ж (Y)
Market Access Monopolistic operators lacking incentives and mandates for third-party access	Ж (Y)
Financial Sustainability Insufficient heating tariffs frozen since 2020, heavy utility debt, unpredictable compensation	Ч (R)
Investment Viability Heat purchase prices capped below gas tariff, eliminating investor returns	Ч (R)
Legal & Regulatory Framework Fragmented authority, undefined third-party access procedures and guarantees	Ч (R)
Infrastructure Reliability Damaged thermal capacity and deteriorated underinvested network prevent reliable heat offtake	Ж (Y)
Political & Security Risk Ongoing attacks on energy infrastructure	Ч (R)

Table 1: Assessment of the investment environment in Ukraine taking the known challenges into account.

Identifying Viable Pathways Despite Constraints

Not all decarbonization options face equal barriers under current conditions. Three categories of energy sources possess characteristics that may allow them to function despite the hostile investment environment:

- **Industrial surplus heat** that already exists as a byproduct requires minimal additional energy input, potentially allowing supply prices that work even within current constraints. The heat is already being produced potentially a quantity of 4-5 TWh of heating (see The Surplus Heat Potential in Ukraine).
- **Multi-revenue facilities** such as biogas plants, biomass CHP units, and waste processing facilities can cross-subsidize heat supply from other revenue streams (electricity sales, waste gate fees, agricultural benefits), enabling heat pricing below standalone thermal production costs. Ukraine has a massive agricultural sector e.g. with an estimated biogas potential of 8.8 billion m3/year.[2]
- **Renewable electricity expansion** that drives down power prices can make electric heating solutions (large-scale heat pumps, electric boilers) economically competitive even when heat

[2] Vaskina, I., Pochwatka, P., Vaskin, R., Adamski, M., Nowak, M., & Dach, J. (2025). Ukraine's biogas potential: a comprehensive assessment of energy yields and of feedstock availability. Sustainable Energy Technologies and Assessments, 81, 104412. https://doi.org/10.1016/j.seta.2025.104412

purchase price caps prevent gas price parity. In addition, large energy parks can be located near district heating systems enabling direct electricity supply to heating equipment and integration with Power to X facilities.

This study focuses on surplus heat integration. Industrial waste heat is the fastest available alternative with the lowest capital cost per heating unit.

The following sections analyze available opportunities and implementation approaches that acknowledge rather than ignore the sector's fundamental challenges.

Zhytomyr case study

Zhytomyr, a regional capital with a population of 260,000, has long relied on an extensive but aging district heating (DH) system. By the late 2000s, the city operated over 200 mostly gas-fired boilers with a combined capacity of 789 MW. This Soviet-era network was oversized, inefficient, and 100% dependent on natural gas. Rising fuel costs and Ukraine's push for energy independence prompted city authorities to launch a modernization strategy.

Between 2007 and 2009, international consultants (SWECO and Seureca/Veolia) audited the system with the support of the EBRD, producing a feasibility study that informed Zhytomyr's first Ten-Year Heating Strategy, which was formally adopted in 2012. The roadmap set clear goals: cut gas consumption by 50% and achieve 25% renewable heat.

While the ecological footprint of alternative fuels was not the city's primary driver, the transition to local renewable resources carried wider sustainability benefits. Biomass combustion, although not always cleaner than gas in terms of local emissions, aligns with a renewable CO_2 cycle. More importantly, it reduces dependence on imported gas, retains revenue in the region, and creates local jobs-framing ecology as a pillar of energy independence, diversification, and resilience.

Implementation progressed in phases:

2009-2012 (Pilot Investments): Even before adoption, the city began "quick wins," supported by a USD 20 million co-financed package from SECO and the municipal budget. Early projects involved upgrading boilers, networks, and piloting biomass boilers, meeting the renewable heat target ahead of schedule.

2012-2017 (Scaling Up): Zhytomyr secured €17 million from EBRD, CTF, and E5P, alongside CHF 12.65 million from SECO. These funds expanded into modernization with biomass CHP, boiler upgrades, and network rehabilitation.

2018-2021 (New Facilities Prepared): Building on progress, the city planned major projects: a 15 MW biomass CHP (€18 million) and a 30 MW waste-to-energy plant (€65 million). A second Ten-Year Strategy (2023–2032) was drafted to continue the transition.

2022-2023 (War-Time Adjustments): Russia's invasion halted large projects, shifting priorities to resilience. Zhytomyr installed 10 modular CHP units (5.6 MW) with donor and city support, creating decentralized "energy islands" for critical districts. Private investors added ~$20 million in emergency generators, though these remained outside the DH network.

2024 and Beyond (Recovery Path): The city now plans to restart the biomass and waste-to-energy plants, expand individual heat substations, and integrate wartime CHP units into long-term design. The updated strategy emphasizes the integration of renewable energy and resilience, aligning with Zhytomyr's goal of achieving climate neutrality by 2050.

Zhytomyr's experience illustrates how a mid-sized city can combine strategic planning, phased investments, donor and private financing, and adaptive measures under crisis conditions to transform its heating system for efficiency, diversification, and resilience.

The full case study including an interview with a donor and key finding can be found in the amendment of this report.

Current situation of Ukrainian District Heating and Third-Party Heat Supply

Analysis of five Ukrainian DH companies regarding their current economic situation, tariff system impacts, and the effects of a “no subsidies”, based on questionnaires, interviews and on recent comprehensive studies (particularly DEA/Rambøll, Green Deal Ukraine, USAID Marked Mechanism, and more) which provide detailed DH company economic analysis and tariff system evaluation.

Focus of this chapter will be specifically on third-party heat supply integration, because:

- Third-party heat represents Ukraine’s most immediate opportunity for cost reduction, decarbonization, and system resilience
- Integration of external heat suppliers is not adequately covered in existing studies
- This focus addresses a practical, implementable solution within the study timeframe

Third-party heat supply encompasses heat from external sources including industrial waste heat, privately-owned heat production facilities (biomass, biogas, solar thermal, heat pumps), energy-intensive facilities (data centers, manufacturing), and other potential heat suppliers outside the traditional municipal DH utility structure.

This chapter will provide:

- Examples of successful third-party heat integration (Ukrainian and international)
- Main barriers to third-party heat supply in Ukraine
- Suggestions for regulatory and contractual approaches
- Recommendations for DH companies to conduct “third-party heat potential mapping” in their service areas
- A table of potential third-party heat sources with recommendations, main barriers and key figures for each opportunity

List of the district heating entities for the study:

- Vinnytsia District Heating Enterprise “Vinnytsiamiskteploenergo”
- Ivano-Frankivsk District Heating Enterprise “Ivano-Frankivskteplokomunenergo”
- Kropyvnytskyi District Heating Enterprise “Teploenergetyk”
- Odesa District Heating Enterprise “Teplopostachannya mista Odesy”
- Cherkasy District Heating Enterprise “Cherkasyteplokomunenergo”

Scope of the study

- General technical status of the enterprises
- Financial status of the enterprises
- Interaction of the enterprises with private investors in the DH sector
- Use of waste heat potential by the enterprises and experience in waste heat utilization in DH systems
- Attitude towards the introduction of market prices for gas

Vinnytsia District Heating Enterprise “Vinnytsiamiskteploenergo”

General information

The total population of Vinnytsia is 400,000.

The district heating utility company “Vinnytsiamiskteploenergo” is owned by the Vinnytsia City Territorial Community, represented by the Vinnytsia City Council. The enterprise provides heat to nearly 95% of all district heating consumers in the city. Out of the total city population, the Enterprise provides district heating services to 42% (166,000 people) and centralized domestic hot water (DHW) services to 26% (105,000 people).

The consumer base by categories:

- Residential: 84.7% (1,212 residential buildings);
- Public Sector: 13.2% (421 consumers);
- Other: 2.1% (402 consumers).

The Enterprise has applied a two-rate tariff since January 2009.

Technical status

Heat Production

The Enterprise’s asset portfolio includes: 48 boiler houses and one CHP plant, 5 cogeneration units with a total capacity of 5.3 MW (with an additional 4 units totaling 10 MW currently being installed). The installed thermal capacity of the generation sources is 933 MW, which exceeds the connected heat load (319 MW) by nearly three times.

In 2024, the enterprise produced 623,143 Gcal of thermal energy. The primary sources of heat generation are gas-fired boiler houses (86%), a gas-fired CHP, and gas-piston cogeneration units (13%). Additionally, the enterprise operates a biomass boiler house (wood chips) with a capacity of 9.5 MW (1%) and a heat pump with a capacity of 170 kW. Almost 99% of the thermal energy is produced from natural gas. The actual energy efficiency of the generation sources is: gas boilers – 92%, biomass boilers – 78%, and the heat pump – 198%.

Heat Transmission

The total length of the heat networks and centralized hot water networks in a two-pipe measurement is 195.7 km. Of this, nearly 108 km (63%) consist of pre-insulated pipes. The share of outdated and emergency-state networks stands at 37%. Total heat losses in the networks are nearly 16%, while heat losses in hot water networks during the non-heating season reach 59%.

The average temperature of the heating networks during the heating season is 70/50°C. The average temperature of the hot water networks is 60/40°C.

Due to significant upgrades of pumping equipment and the implementation of a SCADA system, the enterprise has substantially reduced electricity consumption for heat transport, achieving a figure of 17.7 kWh per 1 Gcal of transported heat.

The Enterprise maintains 59 Central Heat Substations (CHS) and 330 Individual Heat Substations (IHS).

Heat Supply

A total of 1,212 multi-apartment residential buildings with a total heating area of 3.74 million m² are connected to the enterprise's heat networks. 97% of these buildings are equipped with commercial metering units. In 725 residential buildings connected to the network, between 10% and 50% of individual consumers (apartments) have disconnected from the district heating. In 93 buildings, the share of disconnected consumers exceeds 50%.

The volume of thermal energy supplied to residential consumers in 2024 was 110 kWh per 1 m² of residential heating area.

The heat tariff applied to the residential sector has remained unchanged since 2021, at approximately 1,499.82 UAH per 1 Gcal. This tariff covers only 61% of the economically justified tariff established for the enterprise for 2025.

The enterprise also provides heat to 395 public buildings and 374 buildings of other consumers. The established tariff for these categories is economically justified.

Out of the 1,981 buildings in all consumer categories served by the enterprise, 476 buildings (24%) are equipped with IHS, of which 362 feature domestic hot water preparation functions.

Financial status

The enterprise's revenue from its core activity – the supply of thermal energy – totaled UAH 933 million for 2024. An additional UAH 57 million in revenue was generated from auxiliary activities, primarily the sale of electricity produced by the utility's own CHP plant and cogeneration units. However, these combined revenues are insufficient to cover the total necessary operational expenditures, which reached nearly UAH 1.4 billion in 2024. To bridge the deficit between income and expenditure, the enterprise is forced to rely on financial support from the municipal budget.

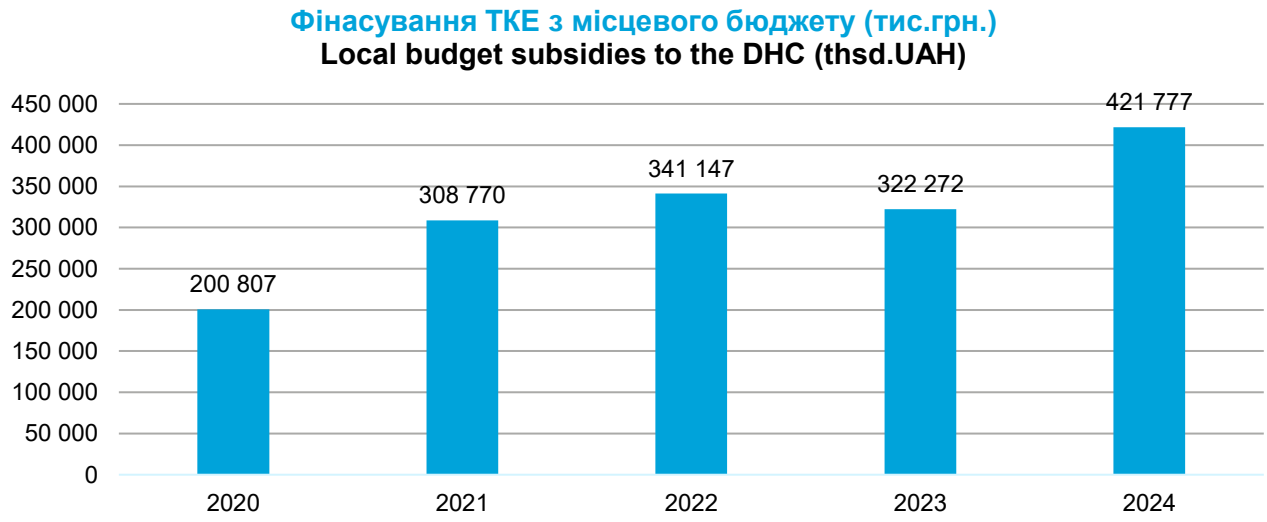


Figure 3: Local budget subsidies to the DHC (thsd.UAH)

This disparity between internal revenue and expenditure is driven by the frozen heat tariffs for the residential sector, which recover only 61% of the enterprise's economically justified costs. By law, this deficit is supposed to be offset by the state budget. However, as of the end of 2024, the tariff compensation owed by the state – duly verified and documented by the enterprise in accordance with legislative requirements – totaled UAH 956 million. This outstanding balance now exceeds the enterprise's total annual revenue from heat sales.

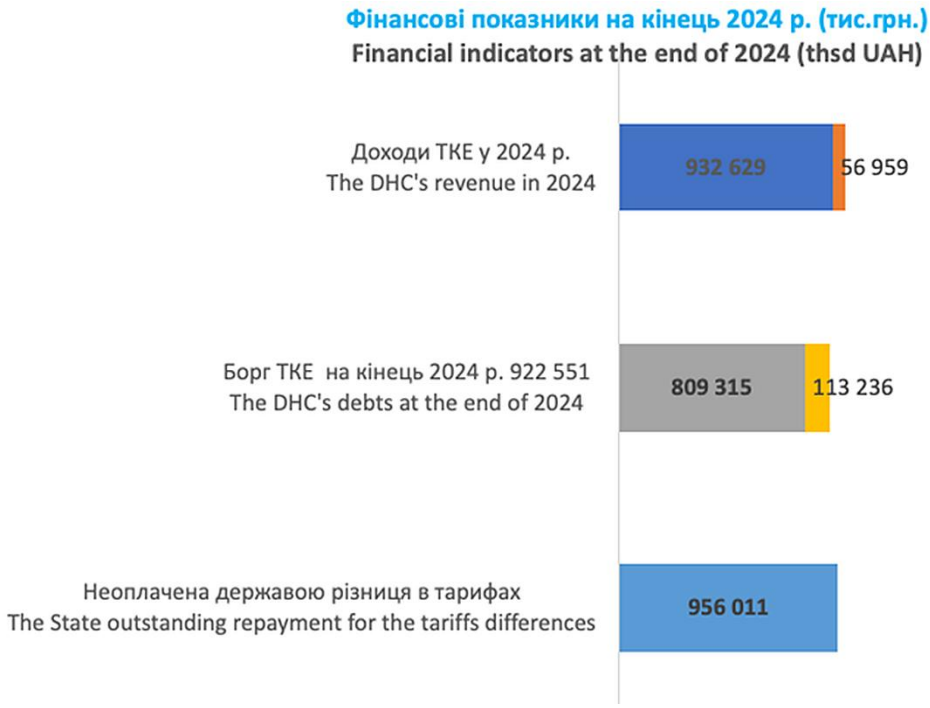


Figure 4: Financial indicators at the end of 2024 (thsd UAH)

Such significant underfunding leaves the utility unable to fully settle accounts with suppliers of goods and services, most notably for natural gas, which is the primary fuel for heat production. As of the end of 2024, the enterprise's total aggregate debt exceeded UAH 923 million, of which UAH 809 million represents arrears for gas supply.

Another consequence of this financial shortfall is the consistent failure to implement the planned investment programme. For instance, in 2024, out of the UAH 46.6 million earmarked for investment activities, only UAH 8.5 million was actually expended. It is important to note that despite these financial challenges, the payment collection rate from the enterprise's customers remains high at nearly 100%.

Development perspectives

Despite a challenging financial landscape, КП ВМР "Vinnytsiamiskteploenergo" remains a dynamically developing enterprise. Over the last five years, a comprehensive suite of renewal and modernisation measures has been implemented:

- Installed 5 Cogeneration units with a total capacity of 5.3 MW(e), with an additional 4 units (with a total capacity of 10 MW) currently under installation.
- Ongoing replacement of legacy heat networks.
- Installation of 95 Individual Heat Substations (IHS).
- Rollout of a city-wide SCADA system.
- Installed 2 economisers (flue gas energy extraction) with a capacity of 350 kW each.
- Installed a 238 kW heat pump unit.
- Nearly all buildings are now equipped with commercial heat and DHW meters.
- Constructed 10.5 km of proprietary 10 kV electrical networks. This has significantly reduced costs for electricity procurement, distribution, and transmission, while ensuring the uninterrupted operation of primary boiler houses during grid blackouts.

These achievements were made possible through the enterprise's proactive engagement in securing international humanitarian and technical assistance in the form of materials and equipment, complemented by co-financing from the local budget. In total, between 2022 and 2025, the enterprise received over UAH 958 million in aid from international donors.

Looking ahead, the enterprise plans to implement a series of innovative energy-efficiency solutions aimed at enhancing energy security and aligning with the EU Energy Efficiency Directive. Key targets include:

- Installing heat pumps with a total capacity of 16.8 MW.
- Expanding high-efficiency cogeneration capacity.
- Installing over 1,000 additional Individual Heat Substations.
- Completing the SCADA system integration.

The intended result of these and other planned measures is a reduction in natural gas consumption by 60 million m³ annually, representing a decrease of over 70% from current levels.

Third-Party Access (TPA) and waste heat recovery

Historically, “Vinnytsiamiskteploenergo” has supplied only thermal energy produced by its own generation assets and has no prior experience collaborating with private heat producers. However, in late 2025, the enterprise launched a pilot project to connect Third-Party heat sources to the network – specifically, waste heat recovery from the cooling systems of a local industrial company. The capacity of these sources is approximately 2 MW.

A formal assessment of the city's total waste heat potential is currently being conducted as part of the updated Municipal Heat Supply Scheme. Furthermore, the enterprise, in partnership with city authorities, is actively seeking investors for the “Reconstruction of Sewage Treatment Plants with Heat Recovery for District Heating” project (for which a feasibility study has already been completed). A core component of this project involves the installation of 8 heat pumps with a total capacity of 16.8 MW to extract thermal energy from wastewater.

Ivano-Frankivsk District Heating Enterprise “Ivano-Frankivskteplokomunenergo”

General information

The total population of Ivano-Frankivsk is 238,000. The district heating (DH) system serves 66,000 residents, representing 28 % of the city's population. Centralized hot water supply is currently not provided to residential buildings; it is supplied only to a specific segment of public buildings.

The Enterprise «Ivano-Frankivskteplokomunenergo» is a communal utility established and owned by the Ivano-Frankivsk City Council.

The enterprise has applied a two-rate tariff for the residential sector since 1999. Since 2012, this two-rate tariff has also been applied to public sector organisations and other commercial consumers.

Technical status

Heat Production

The Enterprise manages 39 boiler houses with a total installed thermal capacity of approximately 377 MW. The capacity mix includes:

- Gas-fired boilers: 361 MW
- Gas-piston cogeneration units: 4.9 MW
- Biomass boilers (wood chips): 11 MW

Approximately 56% of the generation equipment is classified as obsolete. The enterprise operates 26 automated boiler houses without permanent on-site staff; operational data from these sites is transmitted to a central emergency dispatch centre operating 24/7. The total connected heat load is 209 MW.

In 2024, the enterprise produced 196,364 Gcal of thermal energy. Only 6% was generated from renewable energy sources, while 94% was produced from natural gas. The actual thermal efficiency of the sources is 87.9% for gas boilers and 86.4% for biomass boilers.

Heat Transmission

The heat networks length is 129.8 km, of which 66 km (51%) consists of pre-insulated pipes. The share of outdated and emergency-state networks is 49%. Due to the relatively compact network size and the fact that over half of the pipes have been modernised, total heat losses are limited to 11%.

Average operating temperatures during the heating season are significantly lower than design specifications:

- For networks with a design of 130/70°C, actuals are 65/42°C;
- For networks with a design of 110/70°C, actuals are 57/42°C;
- For networks with a design of 95/70°C, actuals are 51/42°C.

Significant upgrades to pumping equipment have resulted in a specific electricity consumption of 18.8 kWh per 1 Gcal for heat transportation. Individual Heat Substations (IHS) have been installed in 53 multi-storey residential buildings and 35 public sector buildings.

Heat Supply

There are 544 multi-apartment buildings connected to the networks, representing a total heating area of 1.9 million m². 85% of these buildings are equipped with commercial metering units.

Network integrity is under pressure: in 412 buildings (approx. 76% of the base), between 10% and 50% of apartments have disconnected from the DH system. In an additional 30 buildings, the disconnection rate exceeds 50%.

The volume of heat supplied to residential consumers in 2024 was 83 kWh per 1 m² of heating area.

Residential tariffs have been frozen since 2021 at 1,681.05 UAH/Gcal, which covers only 68% of the 2025 economically justified tariffs.

Tariffs for public entities and commercial consumers are set at full cost-recovery levels.

For several years, the city authorities and the enterprise have implemented a programme to decommission the large boiler house on Industrialna Street. Residential consumers disconnected under this scheme receive municipal financial grants to install individual heating systems (primarily gas). To maintain supply to public buildings, the enterprise is constructing 10 small-scale autonomous gas boiler houses. In 2024 alone, UAH 28.6 million was allocated from the city budget for individual heating grants – an amount exceeding the total aid provided to the enterprise for DH system development.

Financial status

The enterprise's revenue from its core activity – the supply of thermal energy – totaled UAH 520 million for 2024, which is insufficient to cover all necessary operational expenditures. Each year, the enterprise receives financial assistance from the local budget ranging from UAH 20 to 34 million; however, even this support does not prevent the accumulation of significant debt. As of the end of 2024, the enterprise's total debt to suppliers of goods, works, and services stood at UAH 869 million, of which 88% (or UAH 768 million) consists of arrears for natural gas.

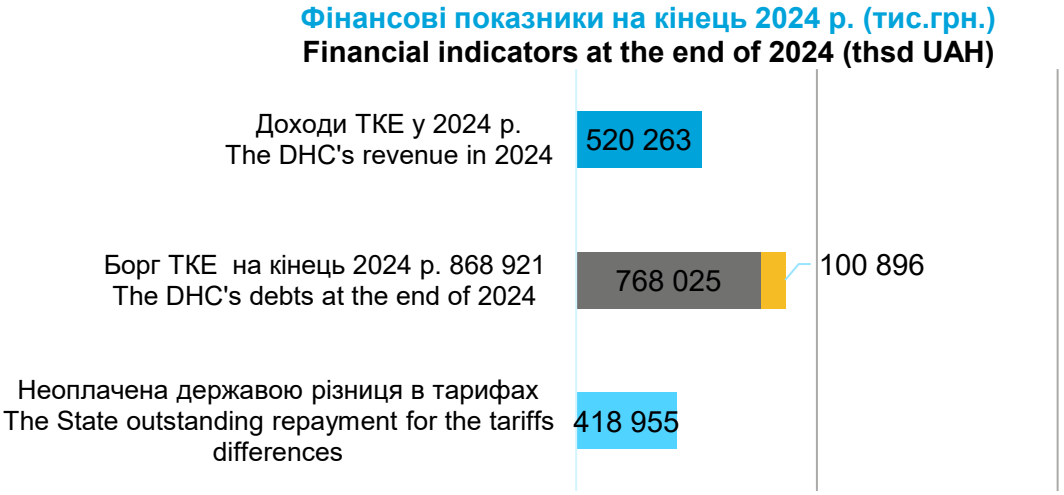


Figure 5: Financial indicators at the end of 2024 (thsd UAH)

The primary cause of these massive debts, which significantly exceed the enterprise's annual revenue, is the frozen heat tariffs for the residential sector. These tariffs recover only 68% of the enterprise's economically justified tarrifs. A further factor is the relatively modest level of financial support provided by the local budget. By the end of 2024, the tariff compensation deficit owed by

the state amounted to UAH 419 million. The enterprise is in a critical financial position; even if the state were to fully reimburse the outstanding tariffs difference, the enterprise would be able to settle less than half of its accumulated debts.

Development perspectives

Despite the complete absence of an investment programme within the heat tariff structure for many years, the enterprise has been implementing measures for the renewal and modernisation of equipment. Over the past five years, the enterprise has:

- Installed a cogeneration unit with a capacity of 600 kW(e);
- Constructed three modular boiler houses, with one more currently under construction and two in the design phase;
- Installed 4 network pumps with frequency converters;
- Installed 88 individual heat substations (IHS).

These measures were carried out with the assistance of international donor organisations (USAID, G.I.Z.) and financing from the local budget.

Additionally, the enterprise's staff has implemented energy monitoring - the collection of energy resource consumption indicators (fuel, water, electricity), their analysis, and the control over equipment performance and personnel.

Given the difficult financial situation, the plans for the further development of the enterprise do not appear ambitious. The enterprise has identified the following priority areas for development and modernisation for the coming years:

- Modernisation of the centralized hot water system: installation of heat pumps at boiler houses that provide heat and hot water to public buildings. This will allow to supply of hot water to these buildings during the non-heating period without using gas boilers.
- Installation of solar collectors at boiler houses as an additional energy source, which will reduce natural gas consumption.
- Implementation of an automated heat accounting system for remote reading of metering devices.

Third-Party Access and Waste Heat Recovery in DH Systems

As of the end of 2025, the utility was leasing the Industrialna Street boiler house and its associated distribution heat network from a private entity. These assets are currently interconnected with the municipal district heating system. The private owner has formally notified both the local authorities and the utility of their intent to cease operations and decommission the facility within the coming year. Consequently, the city has implemented a municipal program to incentivise consumers served by this plant to transition from the DH system to individual heating solutions.

The Enterprise has received no formal expressions of interest from other private heat producers regarding network access or interconnection.

No formal assessment of industrial waste heat potential has been conducted within the city. However, the prevailing view among municipal leadership and the Enterprise management is that Ivano-Frankivsk no longer hosts large-scale industrial enterprises with sufficient thermal output for recovery. Furthermore, the integration of waste heat from remaining small-scale manufacturing is considered commercially unviable due to the prohibitive capital expenditure required for the necessary heating network extensions.

Kropyvnytskyi District Heating Enterprise “Teploenergetyk”

General information

The total population of Kropyvnytskyi is 215,000.

District heating (DH) covers only 17% of the city's population, and centralised hot water supply services are non-existent. Heat supply services are provided by the municipal enterprise “Teploenergetyk” of the Kropyvnytskyi City Council.

Consumer base by category:

- Residential: 98% (11,641 households);
- Public Sector: 1% (134 consumers);
- Other (Commercial): 1% (77 consumers).

The Enterprise applies single-rate tariffs.

Technical status

Heat Production

The Enterprise’s asset portfolio includes 33 boiler houses with an installed thermal capacity of 735 MW. Of these, 21 boiler houses (595 MW) are currently operational. The portfolio also includes the Kropyvnytskyi CHP plant, with an installed electrical capacity of 15 MW and a thermal capacity of 349 MW. The connected heat load is 127 MW, which is approximately 7 to 8 times lower than the installed generation capacity. Since the CHP operates based on heat demand (approx. 40 MWth per hour), its current power generation is only 3.5-3.7 MWe per hour.

In 2024, the enterprise produced 211,393 Gcal of thermal energy, 100% of which was generated from natural gas. The actual thermal efficiency of the gas boilers is 88.6%.

Heat Transmission

The total length of the heat networks in a two-pipe measurement is 154 km. Only 2.9 km (approx. 2%) consists of pre-insulated pipes. The share of outdated and emergency-state networks is 72%. Total heat losses in the networks are exceptionally high at 52%. The average temperature of the heating networks during the heating season was 48/40°C.

Due to the degraded and obsolete state of the pumping equipment, the enterprise consumes 65.2 kWh of electricity to transport 1 Gcal of heat, which is several times higher than the performance indicators of other heating utilities.

The Enterprise operates 6 Central Heat Substations (CHS) and 47 Individual Heat Substations (IHS).

Heat Supply

There are 664 multi-apartment buildings connected to the networks, with a total heating area of 542,000 m². Only 6% of these buildings are equipped with commercial metering units. System fragmentation is extreme: in 577 buildings (nearly 87% of the total), more than 50% of individual apartments have disconnected from the DH network. In another 41 buildings, the disconnection rate is between 10% and 50%. Over recent decades, the number of households connected to the DH networks has collapsed from 66,000 to just 11,600.

Due to massive transmission losses, only 99,000 Gcal reached consumers out of the 211,000 Gcal produced in 2024. The volume of heat supplied to residential consumers in 2024 was 115 kWh per 1 m² of heating area.

The heat tariff for the residential sector has remained frozen since 2021 at 1,671.3 UAH/Gcal. This covers only 34% of the 2025 economically justified cost. Notably, the economically justified tariff for “Teploenergetyk” is twice as high as the weighted average economically justified tariff in Ukraine.

The enterprise also supplies heat to 336 public buildings and 19 buildings of other consumers. Tariffs for these categories are set at full cost-recovery levels.

Financial status

The enterprise's revenue from its core activity – the supply of thermal energy – totalled UAH 320 million for 2024. Additional income included UAH 6.2 million from electricity generation at the CHP plant and approximately UAH 16 million from auxiliary activities (water supply and subscriber services).

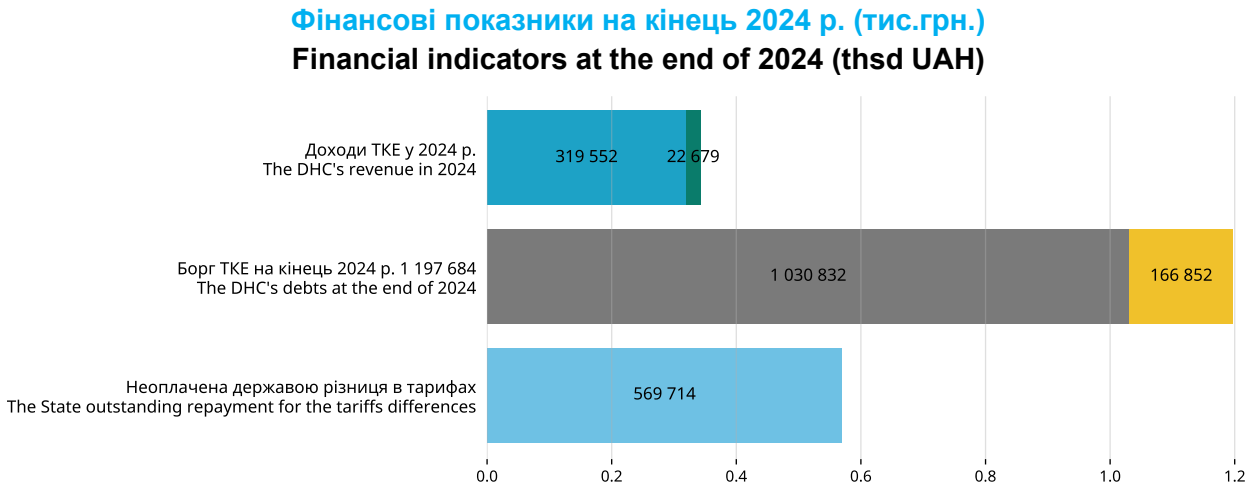


Figure 6: Financial indicators at the end of 2024 (thsd UAH)

Total operational expenditures for 2024 amounted to UAH 656 million. To bridge the deficit between revenue and expenditure, the enterprise receives annual financial support from the municipal budget, typically ranging from UAH 250 to 270 million.

Despite this substantial municipal support, the enterprise's financial position is catastrophic. As of the end of 2024, the total debt to suppliers of goods, work, and services was more than triple the annual revenue, standing at UAH 1.2 billion. Of this amount, over UAH 1 billion represents arrears for natural gas supply.

Even if the state were to reimburse the outstanding tariff compensation – which totalled UAH 570 million at the end of 2024 – these funds would cover less than half of the enterprise's accumulated debt.

Development perspectives

Due to the lack of sufficient funding, the enterprise is unable to undertake modernization measures for its equipment. Investment capital has been absent from the enterprise's tariff structure for many years. Currently, the enterprise only performs maintenance and repair work aimed at sustaining the operational technical state of existing assets.

Among the measures aimed at optimizing the heat supply systems is the enterprise's activity to gradually decommission the inefficient South-Western boiler house, replacing it with 5 block-modular boiler houses located closer to consumers (with a total capacity exceeding 30 MW), as well as the partial replacement of emergency-state trunk heating mains from the CHP plant with diameter optimization.

In July 2024, the Kropyvnytskyi City Council approved the Municipal Heat Supply Scheme for 2023–2032, which provides for:

- The decommissioning of the South-Western boiler house - the most powerful in the city - and the installation of modular boiler houses;
- The transition of the CHP plant to a combined fuel mode: natural gas and biofuels (sunflower husk pellets);
- The optimization of heating networks, including reducing pipe diameters to match the connected heat load;
- The elimination of hybrid heating systems in multi-apartment buildings: transitioning consumers to individual heating systems in buildings where only a small number of apartments remain connected to the DH network;
- The automation of control systems for low-capacity boiler houses.

However, even the implementation of all planned measures will not lead to a significant reduction in the enterprise's dependence on fossil fuels.

Third-Party Access and Waste Heat Recovery in DH Systems

“Teploenergetyk” has issued technical connection specifications to a third-party heat producer proposing the integration of gas-fired reciprocating engine cogeneration units with a total capacity of 18 MW. Financial modeling indicates that thermal energy from these units would be more cost-effective than the heat generated by the utility’s proprietary assets. However, “Teploenergetyk” remains reluctant to commit to a full-volume off-take agreement, as prioritizing this third-party supply would necessitate the curtailment of its own CHP plant. Consequently, the investor has suspended the network interconnection project as of the date of this report.

Furthermore, the formal assessment of industrial waste heat potential was omitted during the drafting of the Municipal Heat Supply Scheme. Despite the presence of four major oil extraction plants within the city – each generating substantial volumes of recoverable waste heat – the Scheme's developers limited their scope to the use of sunflower husks as a primary fuel source for the CHP plant, overlooking the potential for direct thermal energy integration.

Odesa District Heating
Enterprise “Teplopostachannya mista Odesy”

General information

The total population of Odesa exceeds 1 million.

The utility company “Teplopostachannya mista Odesy” (District Heating of Odesa City) is owned by the Odesa Territorial Community, represented by the Odesa City Council. The district heating coverage is notably high, serving 80% of the city's population. Centralised hot water supply services were discontinued in 2019 following a resolution by the City Council.

The breakdown of heat consumption by consumer category:

- Residential: 77% (3,689 residential buildings);
- Public Sector: 16% (777 buildings);
- Other (Commercial): 7% (603 buildings).

The Enterprise applies a single-rate tariff.

Technical status

Heat Production

The Enterprise’s asset portfolio includes 148 gas-fired boiler houses with an installed thermal capacity of 2,112 MW, which exceeds the connected heat load (1,400 MW) by 1.5 times. The share of outdated and emergency-state equipment stands at 54%.

In 2024, the enterprise produced over 1 million Gcal of thermal energy. The actual energy efficiency of the enterprise's generation sources is 90 %. An additional 261,000 Gcal of thermal energy was purchased from the Odesa CHP plant, which operates within the city. The primary shareholder of the Odesa CHP is National Stock Company “Naftogaz of Ukraine”. The system's dependence on fossil fuels is 100%.

Heat Transmission

The total length of the heat and hot water networks in a two-pipe measurement is 617 km, of which only 52 km (8%) are pre-insulated. The share of outdated and emergency-state networks is 60%, leading to significant heat losses in the network amounting to 16.5%.

Due to the obsolescence and degradation of a large portion of the pumping equipment, energy efficiency during heat transmission is relatively low – the enterprise consumes 29.6 kWh of electricity to transport 1 Gcal of heat.

The Enterprise maintains 68 Central Heat Substations (CHS) and 40 Individual Heat Substations (IHS).

Heat Supply

A total of 3,689 multi-apartment residential buildings with a total heating area of 12.7 million m² are connected to the enterprise's networks. 97% of these buildings are equipped with commercial metering units. In 846 residential buildings connected to the networks, between 10% and 50% of individual consumers (apartments) have disconnected from the DH system. In 158 buildings, the share of disconnected consumers exceeds 50%. Overall, the share of apartments disconnected from DH in multi-apartment buildings is approximately 5% of the total number of units connected to

the system. While isolated cases of individual disconnection still occur, a reverse trend is also observed, where consumers who previously disconnected are now reconnecting to the DH system.

The volume of thermal energy supplied to residential consumers in 2024 was 79 kWh per 1 m² of heating area, which is considered a strong performance indicator in Ukraine. This is attributed to climatic conditions (Odesa is located in southern Ukraine on the Black Sea coast) and the relatively high density of the city's urban development.

The heat tariff for the residential sector has remained unchanged since 2021 at 1,511.62 UAH/Gcal. This covers only 62% of the economically justified tariff established for the enterprise for 2025.

The enterprise also supplies heat to 777 public buildings and 603 buildings of other consumers. Tariffs for these categories are set at full cost-recovery levels.

Despite a relatively high level of payment discipline, the total consumer debt for supplied thermal energy exceeds UAH 1.2 billion.

Financial status

The enterprise's revenue from heat supply in 2024 totalled approximately UAH 2.3 billion, with an additional UAH 121 million generated from related activities (such as subscriber services). However, these earnings were insufficient to cover total operational expenditures, which exceeded UAH 3 billion in 2024. The deficit between revenue and expenditure is bridged by annual financial assistance from the municipal budget, ranging from UAH 500 million to UAH 670 million.

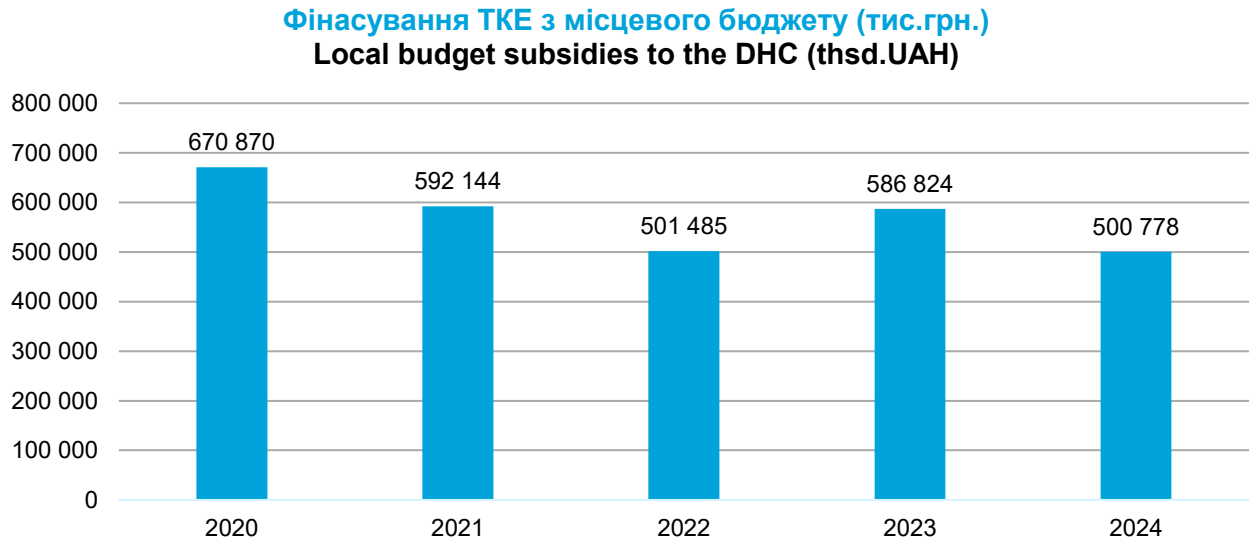


Figure 7: Local budget subsidies to the DHC (thsd.UAH)

Between 2021 and 2023, the enterprise had zero capital for investment activities within its tariff structure. In 2024, less than UAH 3 million was actually utilised for investment out of the UAH 30 million originally planned.

The primary driver of this significant fiscal gap is the moratorium on residential heat tariff increases. Current residential tariffs recover only 62% of the enterprise's economically justified costs. By the end of 2024, the uncompensated tariff deficit owed by the state to “Teplopostachannya mista Odesy” stood at UAH 1.8 billion, rising to UAH 2.1 billion in 2025 – an amount nearly equal to the utility's total annual revenue from heat sales.

As of the end of 2024, the enterprise's total liabilities exceeded UAH 2.9 billion. It is noteworthy that the utility is among the few in Ukraine currently meeting all contemporary gas payments, having successfully restructured its legacy gas debts. The UAH 1.1 billion gas debt recorded at the end of 2024 essentially represents the remaining balance under a formal restructuring repayment schedule. This compliance is made possible through municipal financial aid, which is almost entirely diverted to service current and restructured gas obligations.

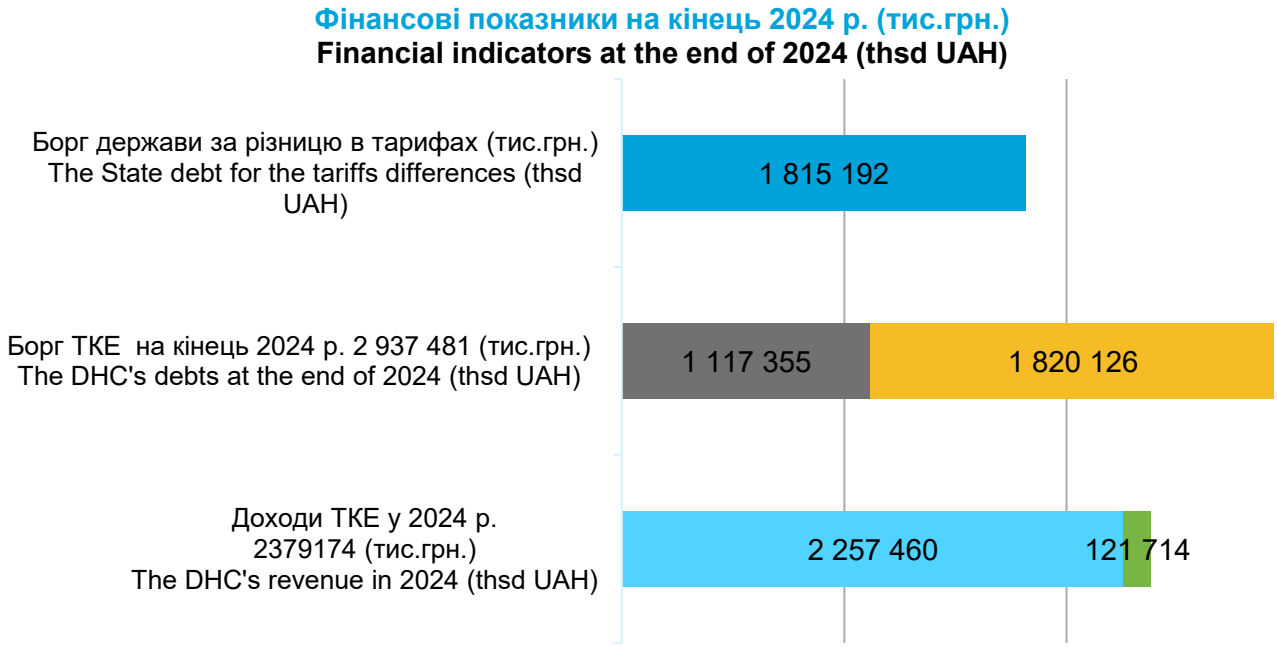


Figure 8: Financial indicators at the end of 2024 (thsd UAH)

The enterprise's financial position could be significantly stabilised if the verified tariff compensation were disbursed from the state budget, as this sum exceeds the utility's total debts to all other suppliers of goods, works, and services (excluding gas).

Development perspectives

Despite the challenging financial environment, "Teplopostachannya mista Odesy" strives to renew its fixed assets and implement modernisation measures. Over recent years, the enterprise has completed the following:

- Installed and commissioned a 3.3 MW(e) cogeneration unit; works are currently underway to install cogeneration units at 9 additional boiler houses with a total capacity of approximately 15 MW(e).
- Replaced 16 network pumps, 6 recirculation pumps, and 12 low-capacity circulation pumps, all equipped with frequency converters.
- Conducted structural repairs on several boiler house buildings, installed a new chimney stack, and carried out major overhauls on over 20 boilers.
- 998 heat metering units were installed.
- Annually replaces 6.5-7 km of heating networks, representing approximately 1% of the total network length.
- Updated the enterprise's vehicle fleet with over 20 units of specialised machinery.

These activities are primarily the result of the enterprise’s success in securing materials and equipment from international donors, supplemented by internal resources. According to the Director, the utility is currently operating in “survival mode”.

Regarding future strategic modernisation, the utility and municipal authorities are working on a project to construct a 40 MW waste-to-energy plant. The project is planned to be funded through international financing – specifically the EDCF credit line from the Government of the Republic of Korea. It is intended that thermal energy from this plant will be supplied to the city centre. There are also plans to evaluate the installation of seawater-source heat pumps. However, the Director does not foresee a significant reduction in the enterprise's fossil fuel consumption in the near term.

Third-Party Access and Waste Heat Recovery in DH Systems

The Municipal Heat Supply Scheme developed in 2021 does not include projects for the recovery of industrial waste heat into the DH systems, with the sole exception of the heat from the proposed waste-to-energy plant to be built under the intergovernmental agreement with South Korea via the EDCF fund.

No formal assessment of waste heat potential was conducted during the development of the Heat Supply Scheme.

According to data provided by the utility, “Teplopostachannya mista Odesy” has received no applications or inquiries from private heat producers regarding interconnection to the heating networks.

Cherkasy District
Heating Enterprise "Cherkasyteplokomunenergo"

General information

The total population of Cherkasy is approximately 300,000. District heating coverage is high, serving over 80% of the population, while centralised hot water supply services reach approximately 65 % of consumers.

The municipal utility “Cherkasyteplokomunenergo” is owned by the city's territorial community, represented by the Cherkasy City Council. The enterprise provides heat to 799 buildings, including multi-apartment residential buildings, public buildings, and other commercial consumers. The utility operates a two-rate tariff system.

Additionally, the city is served by the Cherkasy CHP plant, owned by JSC “Cherkaske Khimvolokno”, which provides heat and hot water to an additional 800 residential buildings with a total heating area of approximately 3 million m².

Technical status

Heat Production

“Cherkasyteplokomunenergo” manages 33 boiler houses with a total capacity of 427 MW. The generation mix is dominated by gas-fired boilers (total installed capacity of 412 MW). The utility also operates 10 cogeneration units with a total capacity exceeding 10 MW and biomass boilers with a total capacity of 4 MW. The share of outdated equipment is relatively low at 30%.

In 2024, the enterprise produced 268,597 Gcal of thermal energy. 98% of this heat was generated using natural gas. The actual thermal efficiency of the generation sources is: gas boilers – 95%, biomass boilers – 75%. An additional 70,000 + Gcal of heat was purchased from the Cherkasy CHP plant.

Heat Transmission

The total length of the heating and DHW networks in a two-pipe measurement is 170 km, of which over 68 km (40%) are pre-insulated. While the share of outdated and emergency-state networks stands at 55%, the system remains highly efficient: total heat losses in the networks are below 10%, and hot water network losses during the non-heating season are approximately 20%.

The average flow temperature during the heating season is 65°C. The average temperature for hot water networks is 55°C. The enterprise is actively implementing measures to reduce return temperatures and minimize water losses within the network.

Due to a comprehensive modernization of pumping equipment over the last 10 years, the utility has reduced electricity consumption for heat transport to 17.4 kWh per 1 Gcal, quite a high-efficiency benchmark. The enterprise maintains 81 Central Heat Substations (CHS).

Heat Supply

There are 451 multi-apartment buildings connected to the utility's networks, with a total heating area of 2.2 million m². 100% of these buildings are equipped with commercial metering units. Due to the consistent policy of the municipal authorities and utility management to preserve the integrity of the heating systems, there are no cases of individual apartment disconnections from the DH networks in Cherkasy.

The volume of thermal energy supplied to residential consumers in 2024 was 98 kWh per 1 m² of heating area.

The residential heat tariff remains frozen at the 2021 level of 1,255.02 UAH per 1 Gcal, which is relatively low and covers only 58% of the economically justified tariff set for 2025. Tariffs for the 263 public buildings and 85 other commercial buildings remain at economically justified (full cost-recovery) levels.

In total, 347 buildings are equipped with Individual Heat Substations (IHS), 158 of which include hot water preparation functions.

Financial status

“Cherkasyteplokomunenergo” stands as one of the few district heating utilities in Ukraine that operated profitably prior to 2022 (the onset of the full-scale invasion) and historically required virtually no financial subsidies from the local budget.

In 2024, the enterprise's revenue from its core activity – heat supply – amounted to UAH 688 million. An additional UAH 113 million was generated through auxiliary activities, including the sale of electricity produced by the utility’s proprietary cogeneration units. Furthermore, UAH 78 million was provided from the municipal budget.

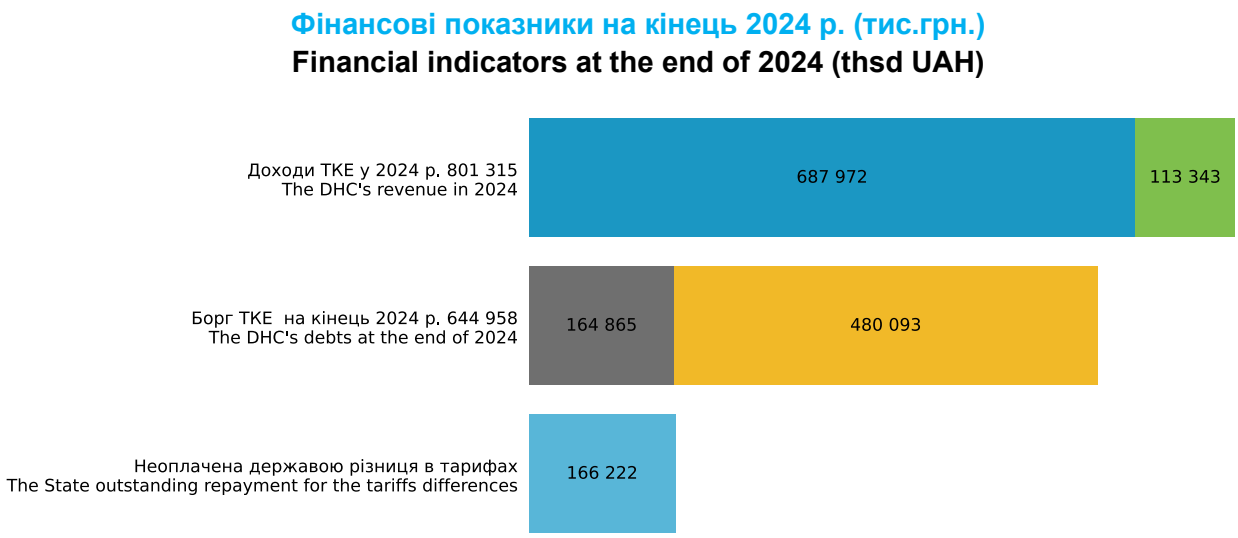


Figure 9: Financial indicators at the end of 2024 (thsd UAH)

The utility maintains a relatively low debt profile for natural gas, totalling approximately UAH 165 million at the end of 2024. Other liabilities at the close of 2024 amounted to UAH 480 million; however, the majority of this figure consists of scheduled repayments for an investment loan from the EBRD and the future accounting recognition of income from humanitarian aid received. Arrears for goods and services primarily involve debts to the Cherkasy CHP plant for purchased heat; notably, these are almost entirely offset by the CHP plant's own debts to the utility for heat transmission services via the "Cherkasyteplokomunenergo" network.

The outstanding tariff compensation owed by the state stood at UAH 166 million at the end of 2024. Consequently, the disbursement of these funds from the state budget would allow the enterprise to settle its gas debts in their entirety.

Development perspectives

The management of “Cherkasyteplokomunenergo” is consistently executing a phased, long-term development plan. During previous stages, the following milestones were achieved:

- Boiler Modernization: Installation of fire-tube boilers equipped with economizers and high-efficiency modulating burners.
- Infrastructure Upgrades: Replacement of a significant portion of pumping equipment and over 60 km of heating networks.
- Power Generation: Installed 10 cogeneration units (CHP) with a total electrical capacity of 8 MW(e) and 5 gas-fired power generation units totaling 9.5 MW(e).
- Resilience & Renewables: Installed electrical battery storage at 18 boiler houses and 8 Central Heat Substations (total capacity 1.2 MW), and solar panels at one boiler house (8 kW).

These measures have yielded substantial operational results:

- 42% reduction in natural gas consumption.
- 2.2x reduction in total consumption and an 80% reduction in power distribution costs.
- 4x reduction in costs for water procurement and treatment.
- Achieved full operational autonomy during grid blackouts.

Funding for these initiatives included an EBRD loan of €11.2 million, nearly UAH 600 million in humanitarian aid (materials and equipment), municipal co-financing, and the utility's own revenue from electricity sales. The enterprise has consistently exceeded its investment program targets for many years.

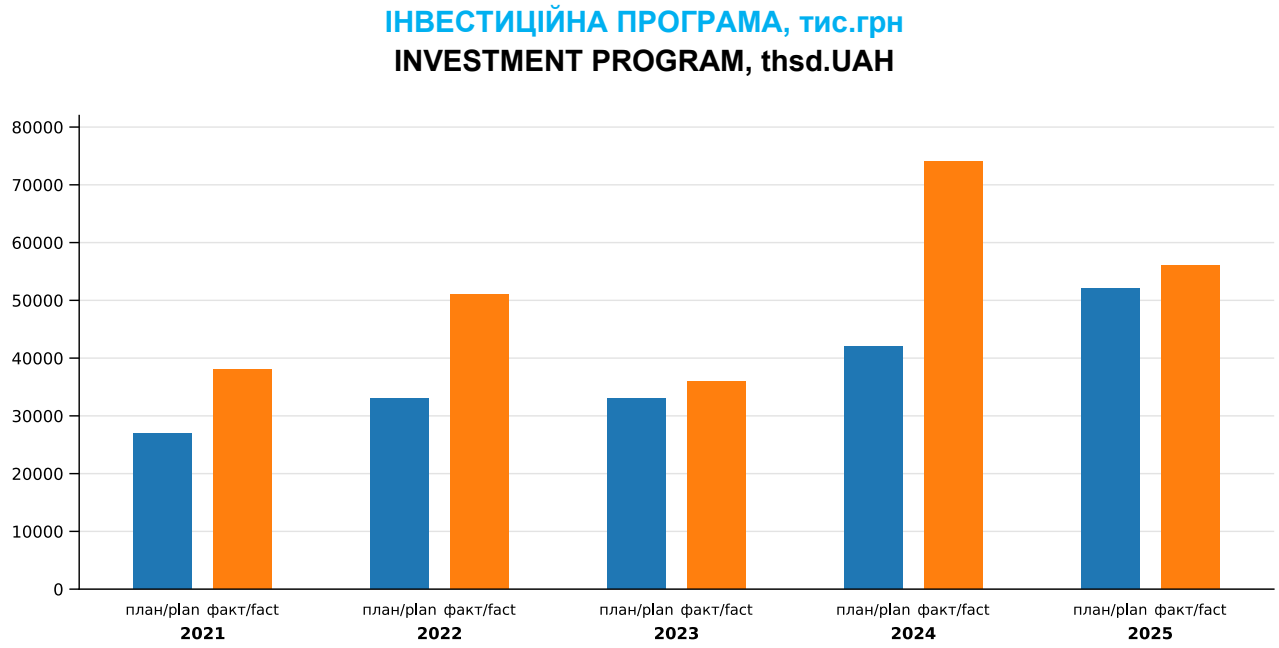


Figure 10: Investment Program Overview

Future development stages include:

- Construction of a plant utilizing wood chips and RDF with termal capacity of 88 MWth and 25 MWe.
- Construction of large-scale thermal energy storage tanks.

- Installing solid-fuel boilers (up to 5 MW) at all boiler houses, relegating gas boilers to peak-load and backup functions only.
- Network looping, transitioning to quantitative regulation, and completing the transition to a two-pipe system with IHS installation.
- Implementing Artificial Intelligence (via the Deahl project) for automated data collection, predictive analytics, demand-side management, and weather-compensated control.
- Establishing an in-house wood chipping facility to decentralize fuel procurement.

Expected outcomes: 72–80% reduction in natural gas consumption, a transition to renewable energy sources, and enhanced system flexibility through demand-side regulation.

Third-party access and waste heat recovery

In 2025, a private biomass CHP plant (wood waste) with a thermal capacity of 9 MW was connected to the utility's network. The enterprise signed a long-term Heat Purchase Agreement to off-take the full volume of thermal energy, provided the price remains lower than the utility's own production costs. This interconnection also serves a critical security function: it can maintain the district heating system above freezing temperatures during potential gas supply disruptions.

A comprehensive assessment of industrial waste heat potential in Cherkasy has not yet been conducted. The management of “Cherkasyteplokomunenergo” explored the possibility of recovering waste heat from the “Azot” enterprise, Ukraine’s largest nitrogen fertilizer producer. However, the management of “Azot” has not expressed interest in implementing a waste heat recovery project for the DH system currently.

Major technical characteristics of five studied Ukrainian DHCs

	Vinnytsia	Zhytomyr	Ivano-Frankivsk	Kropyvnytskyi	Odesa	Cherkasy
Heat production						
Installed thermal capacity, MW	933	792	377	880	2112	427
Connected heat load, MW	319	337	209	127	1400	207
Share of outdated equipment, %	n/a	35	56	n/a	54	30
General amount of produced heat energy in 2024, MWh	724 715	461 684	228 330	245 850	1 164 743	312 378
Dependency on fossil fuel (natural gas), %	99	99	94	100	100	98
Heat transmission						
Length of the network, km	196	202	130	154	617	170
Share of pre-insulated pipelines, %	63	21	51	2	8	40
Share of outdated and emergency-state networks, %	37	33	49	72	60	55
Heat loss in the networks, %	16	11	11	52	16	9,5
Specific consumption of electric energy per 1 Gcal of transported heat energy in 2024, kWh/Gcal	17,6	n/a	18,8	65,2	29,6	17,4
Heat supply						
Number of residential buildings connected to the heating networks	1212	940	544	664	3 689	451
Share of residential buildings equipped with commercial meters, %	98	74	90	6	97	100
Share of buildings with over 50 % individual consumers disconnected, %	8	6	6	87	4	0
Floor area heated in residential buildings, thsd.m^2	3 737	2 927	1 886	542	12 676	2 225
Heat volume per 1 m2 of heated area of residential buildings in 2024, kW/m2	110	121	83	115	79	98
Number of connected public buildings and buildings of other consumers	769	575	394	355	1 380	348

Table 2: Technical characteristics of five studied Ukrainian DH companies

Conclusion

1. Attitude of municipal administrations toward connecting to and disconnecting from district heating (DH) is a critical factor in the DH systems viability

District heating systems are local engineering systems owned by territorial communities. The trajectory of these systems - whether they thrive or decline - is directly dictated by the strategic stance of municipal authorities and their commitment to the networks integrity.

Ivano-Frankivsk: The local authority provides financial incentives for residents in high-density central districts to disconnect from the DH network in favour of individual gas boilers or electric heating in every flat.

Kropyvnytskyi: Years of unrestricted permits for individual apartment disconnection have hollowed out the network, leading to extreme operational inefficiencies and bringing the system to the brink of collapse.

Cherkasy: Conversely, by prohibiting individual disconnections, the city has maintained one of the nation’s most efficient DH systems, facilitating dynamic corporate growth for the utility.

Vinnytsia & Odesa: While thousands of apartments previously disconnected, the rate has slowed significantly and no longer poses a systemic threat. Notably, in Odesa, some owners of previously disconnected flats are now applying for reconnection to the DH system.

2. Politically motivated tariff decisions have made DH companies dependent on assistance from local budgets and international donors

Heat supply utilities continue to operate under residential tariffs frozen at 2021 levels, which currently recover only 34% to 68% of economically justified costs. This is the result of the state policy to prevent an increase in heating tariffs for the population, which was initiated by the Government back in 2021, and in July 2022, a moratorium on tariff increases was established by Law. By the Law, the state is required to compensate utilities for the deficit between frozen tariffs and the economically justified tariffs.

In practice, these state compensation funds have not been disbursed. The accumulated debt owed by the state over the last three years now approaches or exceeds the annual gross revenue of these utilities. Consequently, heat providers have accrued massive arrears with upstream suppliers, particularly for purchased heat from other producers, and most of all for gas supply. To manage gas payments, a Government Resolution mandates that 65% of all utility revenue for the heat supply be automatically diverted to the gas supplier, further crippling the utilities' liquidity.

To prevent total insolvency of the DH utilities, city administrations are forced to divert hundreds of millions of Hryvnias from local budgets annually to cover mostly operational expenses.

Meanwhile, modernization is almost entirely reliant on international donor aid (materials and equipment). However, this support is disproportionately allocated to "proactive" utilities that demonstrate high technical and human capacity and a clear strategic vision and development plan backed by the municipality.

3. District heating utilities are utilities remains critically over-reliant on natural gas and don't have funds to invest in alternative energy sources

The fuel mix for DH utilities remains critically over-reliant on natural gas (ranging from 94% to 100%). Due to their distressed financial state, these enterprises lack the internal reserves to invest

in the transition to renewable energy sources. In four out of five surveyed entities, investment programs were either not included in the tariff or had a low level of implementation.

In Ivano-Frankivsk and Kropyvnytskyi, investment programmes were excluded from the tariff structure entirely. In Odesa and Vinnytsia, implementation rates for planned investment plans remain low.

Cherkasy serves as an outlier; its investment programme was over-delivered, funded by revenue from other activities specifically the sale of electricity generated by its own cogeneration units.

Attracting loans for DH utilities is possible only under guarantees from the municipalities, which, given the current financial status of the utilities, means an additional increase in the financial burden on local budgets.

4. District heating companies do not use the potential of industrial waste heat at all.

The actual flow temperature of heating networks under current climatic conditions is mostly 65 degrees Celsius and below in the supply pipeline. This lower temperature profile significantly expands the range of industrial sites from which waste heat could be recovered, often without the need for additional warming up of the heat flow.

The main reasons for the lack of examples of industrial waste heat integration in DH systems in Ukraine include:

- A lack clear requirements for Heat Supply Scheme developers on mandatory conduction of waste heat potential assessment.
- Low awareness among utility managers regarding the technical feasibility of waste heat integration.
- A lack of commercial incentives for industrial enterprises to supply waste heat to the DH network.

Among the cities studied, none had conducted a waste heat potential assessment during the development of their municipal Heat Supply Schemes. Only Vinnytsia has recently included a requirement of waste heat assessment in the Terms of Reference for the Heat Supply Scheme updating in 2026.

Impact of Market Gas Pricing on the District Heating Sector

This section presents the results of a survey of directors of district heating companies covered by this study on the impact of setting a market price for gas on their companies and the development of district heating systems in Ukraine.

1. The DH Enterprises' Directors Forecasts: Operational Risks and Strategic Challenges

The transition to market-based energy pricing will exert varying degrees of pressure on district heating systems and on DH enterprises based on their current status:

Kropyvnytskyi: The application of market prices poses a risk of total systemic collapse, as the district heating utility will be financially incapable of meeting gas procurement costs. Furthermore, municipal budgets will be unable to sustain the current level of subsidies. Immediate network modernization is required to preserve heating capabilities, primarily for public buildings.

Odesa: Tariffs are projected to increase more than twofold. This spike will likely lead to widespread consumer insolvency and the subsequent collapse of the DH infrastructure.

Ivano-Frankivsk: Massive requests for disconnection from the DH network are anticipated, even in areas where individual heating was not previously prevalent. The long-term viability of DH will depend entirely on its economic competitiveness relative to individual solutions.

Vinnytsia: Consumers disconnect from the network for only one reason: if individual heating becomes cheaper for them. If the DH Company can provide the service more cheaply, the population will remain with DH. DH systems have great potential to reduce the cost of heat by switching to cheaper alternative energy sources; such opportunities are limited in individual heating. The government should provide targeted subsidies to the population.

Cherkasy: In the first period of time, this will be a price shock. Then the adaptation process will begin. DH will only be preserved in those cities where the local authorities are interested in investing in its development or attracting private investment. Reducing costs and improving the quality of heating must become a priority for local authorities.

Zhytomyr: The tariff will increase by more than 2 times, so it is necessary to implement gradual, rather than a one-time increase in the cost of gas, at least over three years. During this time, both consumers will be able to prepare (insulate buildings) and the DHC will be able to make heat cheaper by partially replacing gas with more affordable alternative energy sources.

2. Adaptation Strategies and Sustainability Requirements

For cities with high development potential (Vinnytsia, Cherkasy, Zhytomyr), the following priorities have been identified to ensure system survival:

Economic Competitiveness: Consumers will only remain connected to the DH network if the utility can provide services at a cost lower than that of individual heating.

Alternative Energy Integration: DH systems possess a unique advantage in their ability to transition to cheaper alternative energy sources – an option that is significantly restricted for individual heating.

Investment and Quality: The preservation of DH is contingent upon local authorities' commitment to modernization, quality improvement, and the attraction of private investment.

Transition Period: To mitigate the “price shock”, it is recommended to implement gas price increases gradually over a three-year period (at least). This timeframe allows consumers to conduct thermal retrofitting and enables DHCs to integrate lower-cost fuel alternatives.

3. Policy Recommendations for the Government

To ensure a level playing field between centralized and individual heating, the Government should implement the following structural reforms:

- Market-Based Utility Pricing: Adoption of market prices for gas, electricity, and water for all consumer categories, including the elimination of Public Service Obligations (PSO) and preferential rates for the population.
- Direct Social Support: Transition from broad energy subsidies to targeted, direct financial support specifically for vulnerable consumer groups.
- Environmental Accountability: Introduction of carbon emission charges for all end-users, including the residential sector.
- Technical Compliance: Implementation of mandatory annual technical maintenance for individual gas boilers to ensure safety and security of its exploitation.

Third Party Access in the form of Surplus Heating to District Heating

Third-party access (TPA) represents an opportunity for district heating utilities to reduce heat production costs and expand system capacity without major capital investments by integrating heat from independent suppliers.

These third-party suppliers, be it industrial facilities with surplus heat, private cogeneration plants, renewable energy producers, data centers, and other energy-intensive operations, can potentially provide heat at competitive prices while solving their own cooling or energy needs.

Through collaborative agreements, utilities gain access to cost-effective heat sources that improve their competitiveness against individual heating solutions, while industrial partners monetize previously wasted energy and reduce their own operational costs.

Successful TPA partnerships create mutual benefits: utilities secure cheaper heat that strengthens their market position, industrial suppliers generate revenue from waste streams, and both parties contribute to decarbonization goals.

Ideally the framework establishes transparent connection procedures and fair pricing mechanisms that enable these win-win collaborations, allowing utilities to diversify their heat supply portfolio and enhance system resilience while maintaining reliable service to consumers.

What is Surplus/Waste Heat

Among the various types of third-party heat sources, industrial surplus heat stands out as Ukraine's most immediate and promising opportunity.

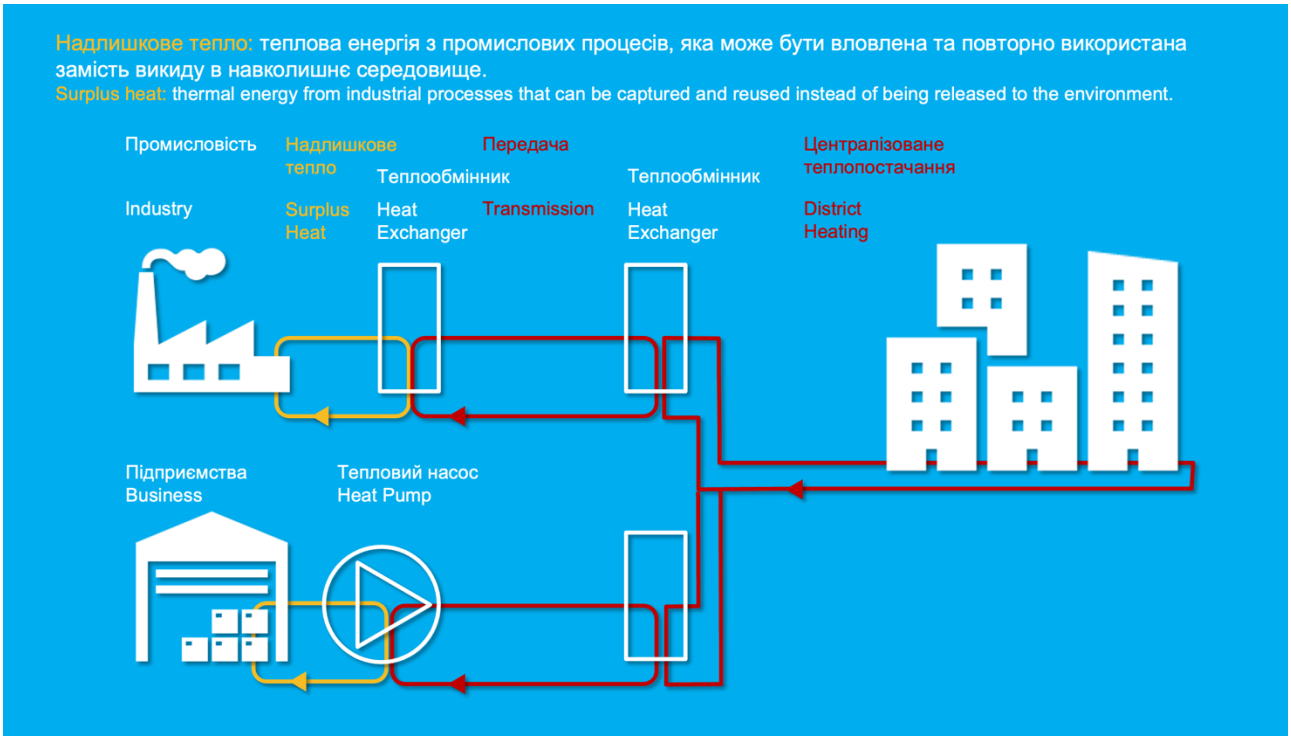


Figure 11: The principle of surplus heat utilization.

Surplus heat, also called waste heat or excess heat, is thermal energy generated as a by-product of industrial manufacturing processes that must currently be removed through cooling systems such as cooling towers, chillers, or direct water cooling.

Industries ranging from food processing and chemical production to data centers and manufacturing facilities continuously generate heat across a wide temperature spectrum:

- low-temperature surplus heat up to 70°C is very common and represents the largest available volume,
- medium-temperature heat between 70°C and 100°C is common across many industrial processes,
- while high-temperature surplus heat above 100°C is less frequently available but offers higher energy value and greater flexibility for integration.

The technical setup is straightforward: heat exchangers at the industrial site transfer the surplus heat to a transmission pipeline, which delivers it to the district heating network either directly or through a second heat exchanger that maintains hydraulic separation between the industrial and municipal systems (see Figure X).

- For industrial facilities, this transformation of waste heat into a valuable product reduces cooling costs while generating revenue.
- For district heating utilities, it provides a constant, reliable heat source at costs significantly below gas-fired production.

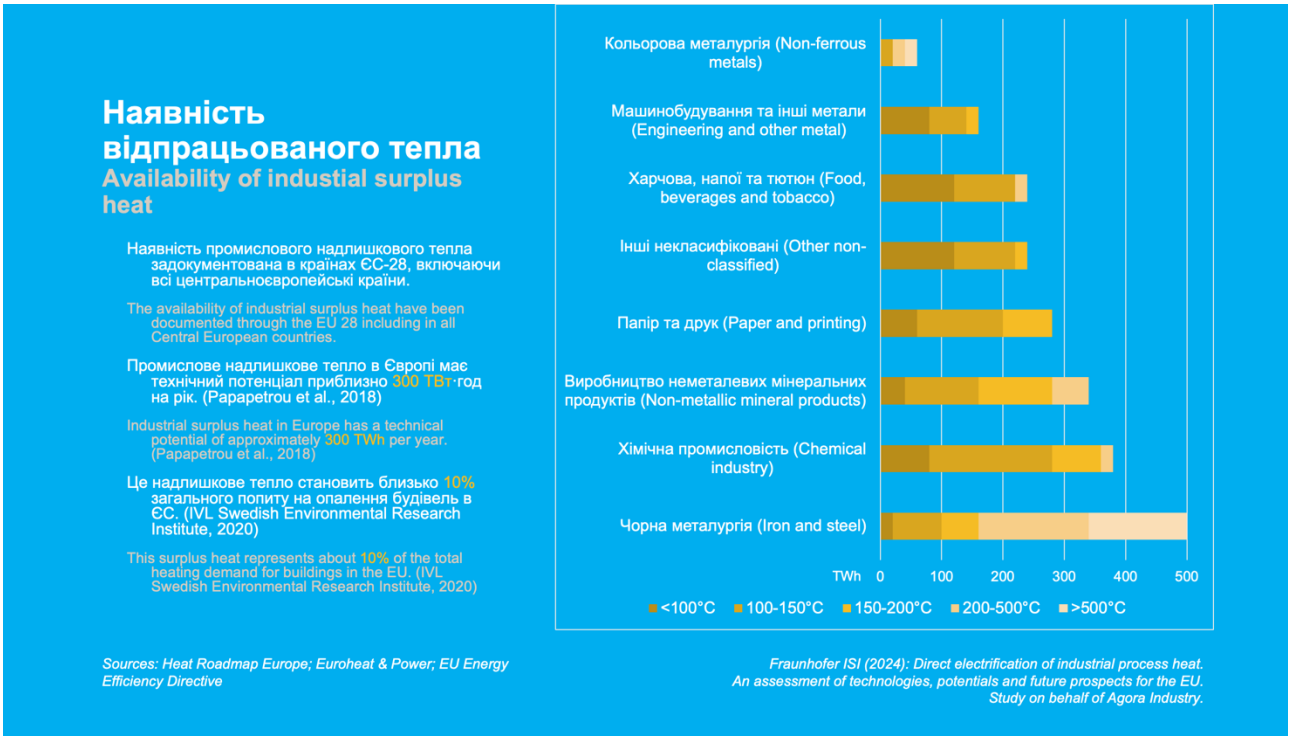


Figure 12: Surplus heat is generally available at a wide range of temperatures

With Ukrainian district heating systems commonly operating at supply temperatures of 65°C and below during much of the heating season, even the most common low-temperature industrial surplus heat becomes a viable supply source.

The Surplus Heat Potential in Ukraine

Industrial surplus heat represents a significant untapped energy resource across Europe. Recent analysis estimates the technical potential for industrial surplus heat in Europe at approximately 300 TWh per year (300,000 GWh).[3] This substantial volume reflects the inherent inefficiency of many industrial processes where heat must be removed through cooling systems to maintain operations. While European-wide assessments provide useful context, understanding Ukraine's specific surplus heat landscape requires examination of the country's particular industrial structure, geographic distribution, and existing utilization patterns. Ukraine's industrial base suggests considerable theoretical potential for surplus heat utilization in district heating. However, reliable current data remains limited.

A 2022 analysis by the Renewable Energy Agency[4] examined pre-war industrial waste heat potential. It provides what may be the most comprehensive assessment available despite acknowledged data constraints. The study estimated total thermal waste heat generation at approximately 23,300 GWh annually (20 million Gcal) and of this up to some 14,000 GWh per year (12 million Gcal) was considered technically extractable under favorable conditions.

These estimates, however, are primarily based on pre-war 2010 production data. Since that time, Ukraine's heavy industry has been destroyed to a significant degree. We can consider a very theoretical loss of capacity based on public information and get an estimate as follows:

Industry Category	Original Potential (2010) GWh	Theoretical Loss %	Theoretical Remaining Potential (2024) GWh
Ferrous metallurgy (incl. coke plants)	8120	100%	0
Chemical and petrochemical industries	3920	25%	2940
Construction materials	560	0%	560
Fuel industry (excl. coke plants)	280	75%	70
Metalworking and machinery	280	0%	280
Non-ferrous metallurgy	70	0%	70
Other industries	770	0%	770
TOTAL	**14000**	**34%**	**4690**

Table 3: Theoretical estimate of the waste heat potential in Ukraine

An estimate based on data that is more than a decade old and predates the war provides limited insight into the actual potential of waste heat in Ukraine. Nevertheless, it does indicate the presence and volume of waste heat within the country. As discussed previously, Ukrainian district heating systems frequently operate at supply temperatures of 65°C or lower for much of the heating season. This allows for the utilization of industrial surplus heat at reduced temperature ranges.

---

[3] Agora Industry (2024). *Electrification of Industrial Heat*. https://www.agora-industry.org/fileadmin/Projects/2023/2023-20_IND_Electrification_Industrial_Heat/A-IND_329_04_Electrification_Industrial_Heat_WEB.pdf

[4] Kramar, V., & Oliinyk, Y. (2022). Analysis of waste heat and geothermal heat potentials for district heating in Ukraine. Renewable Energy Agency.

Consequently, there may be greater economically viable opportunities at lower temperatures than those suggested by the study. The estimated 4,700 GWh of surplus heat could provide heating for about 500,000 apartments, assuming each apartment uses 11.5 MWh per year.

The Kramar/Oliinyk study mentions distance between industrial facilities and residential consumers as a significant barrier. However, as will be shown later in this study, comparing the total cost of ownership (TOTEX) between a transmission pipeline investment and an alternative gas boiler investment can demonstrate substantial feasible transmission distances (10 km+) for surplus heat. The distance constraint, therefore, may be less limiting than initially suggested.

Examples of Surplus Heat utilisation

Aalborg District Heating – Aalborg Portland; Large scale surplus heat utilization case

Aalborg Portland, one of Northern Europe's largest cement producers with annual production of 3 million tons, demonstrates how heavy industry and district heating can create lasting partnerships. Since 1990, the cement plant has supplied surplus heat to Aalborg Forsyning, the municipal district heating utility serving Denmark's fourth-largest city with 34,000 connections and 2,100 GWh annual heat demand.

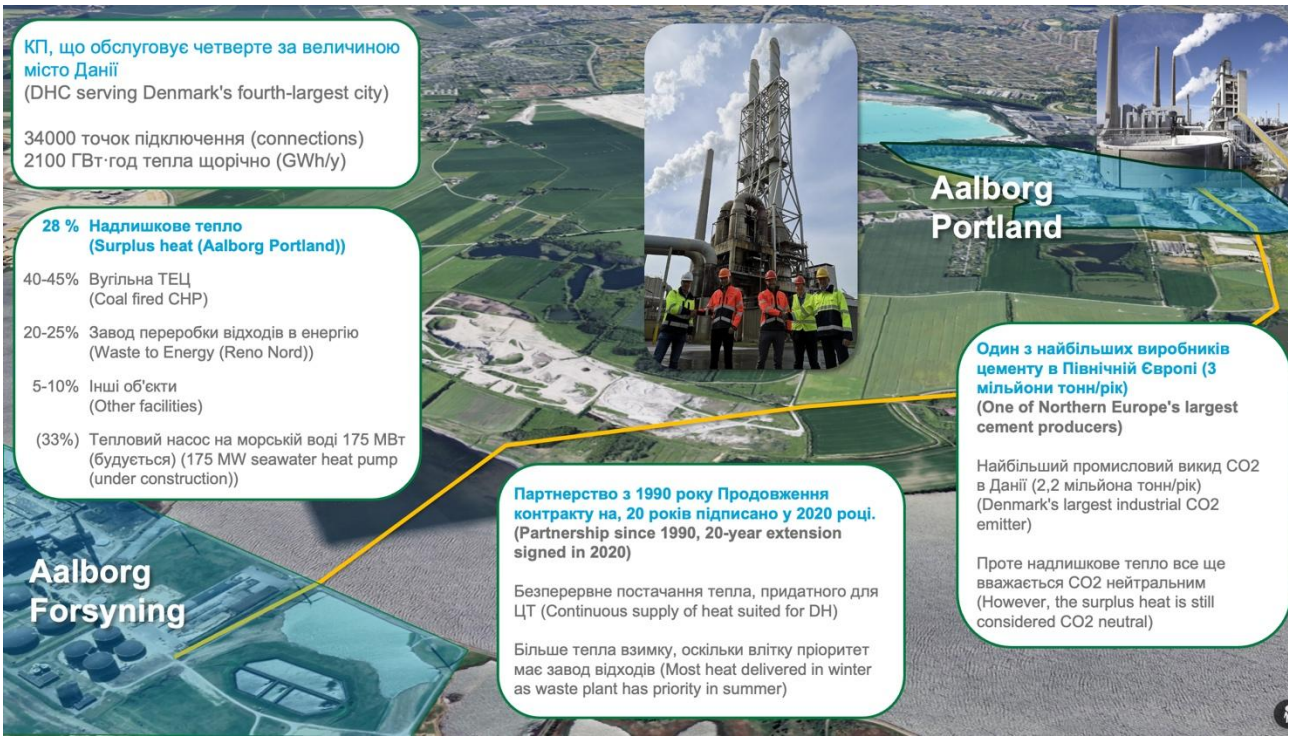


Figure 13: For over 30 years Aalborg Portland have provided surplus heat to Aalborg District Heating

In 2020, the partnership was extended by 20 years and expanded to increase the surplus heat share from 20% to 28% of the utility's total heat supply, now heating approximately 30,000 households. The technical solution captures heat from flue gases at the cement production line, where temperatures of 65 to 75°C are recovered through combined flue gas cleaning and heat recovery systems[5]. This continuous heat supply is particularly valuable during winter months when demand peaks, delivering approximately 1,500 TJ annually. The surplus heat is classified as

CO2-neutral despite cement production being Denmark's largest industrial CO2 emitter, resulting in annual CO2 savings of 150,000 tons[6] compared to alternative heat sources.

The partnership's success lies in its long-term commitment and mutual benefits: Aalborg Portland monetizes waste heat while reducing cooling costs, Aalborg Forsyning secures stable, cost-competitive heat supply, and both parties contribute to regional decarbonization goals. Future expansion potential exists to double the surplus heat delivery if additional production lines are equipped with heat recovery systems. The technical solution captures heat from flue gases at the cement production line, where temperatures of 65 to 75°C are recovered through combined flue gas cleaning and heat recovery systems[7]. This continuous heat supply is particularly valuable during winter months when demand peaks, delivering approximately 1,500 TJ annually.

The surplus heat is classified as CO2-neutral despite cement production being Denmark's largest industrial CO2 emitter, resulting in annual CO2 savings of 150,000 tons[8] compared to alternative heat sources.

The partnership's success lies in its long-term commitment and mutual benefits: Aalborg Portland monetizes waste heat while reducing cooling costs, Aalborg Forsyning secures stable, cost-competitive heat supply, and both parties contribute to regional decarbonization goals. Future expansion potential exists to double the surplus heat delivery if additional production lines are equipped with heat recovery systems

Aalborg District Heating – IKEA; Dual purpose cooling and surplus heating case

The IKEA Aalborg case exemplifies an innovative approach to third-party access where the district heating utility invests in infrastructure that simultaneously serves both parties while generating multiple income streams.

When IKEA needed to replace four aging HFC refrigeration systems for their large retail warehouse, Aalborg Forsyning proposed a partnership based on sector integration, combining district cooling and heating production in a single, efficient system that benefits both the retailer and the utility.

Aalborg Forsyning constructed a local energy center directly on the IKEA site, housed in a compact prefabricated technical cabin[9] measuring 10 x 3.4 meters. The installation features a Fenagy H-1200 air-to-water heat pump[10] with integrated cooling module, using CO2 as a natural refrigerant, with a cooling capacity of 750 kW to 1 MW and heating capacity of 1.2 MW. The complete system was delivered as a turnkey, plug-and-play solution, installed and commissioned within just 26 weeks from order to full operation in autumn 2023.

The technical solution operates on a seasonal cycle that maximizes energy utilization throughout the year. During summer months, the system provides cooling to IKEA's warehouse and retail spaces, with the surplus heat generated during this cooling process, available at temperatures suitable for district heating, being captured and fed directly into Aalborg Forsyning's district heating network. In winter months, the air-source heat pump extracts heat from ambient air to provide

[7] https://ing.dk/artikel/cement-plant-supplies-25-percent-district-heating-aalborg-we-could-supply-50-percent
[8] https://www.cementirholding.com/en/media/whats-new/cementir-expands-supply-sustainable-heating-denmark
[9] https://priess-web.com/case/technical-cabins-offer-flexible-solution-for-a-climate-friendly-transition/
[10] https://www.fenagy.dk/en/case-ikea

heating for both IKEA's facilities and the district heating network. This dual-mode operation ensures year-round productivity and revenue generation from the same infrastructure investment.

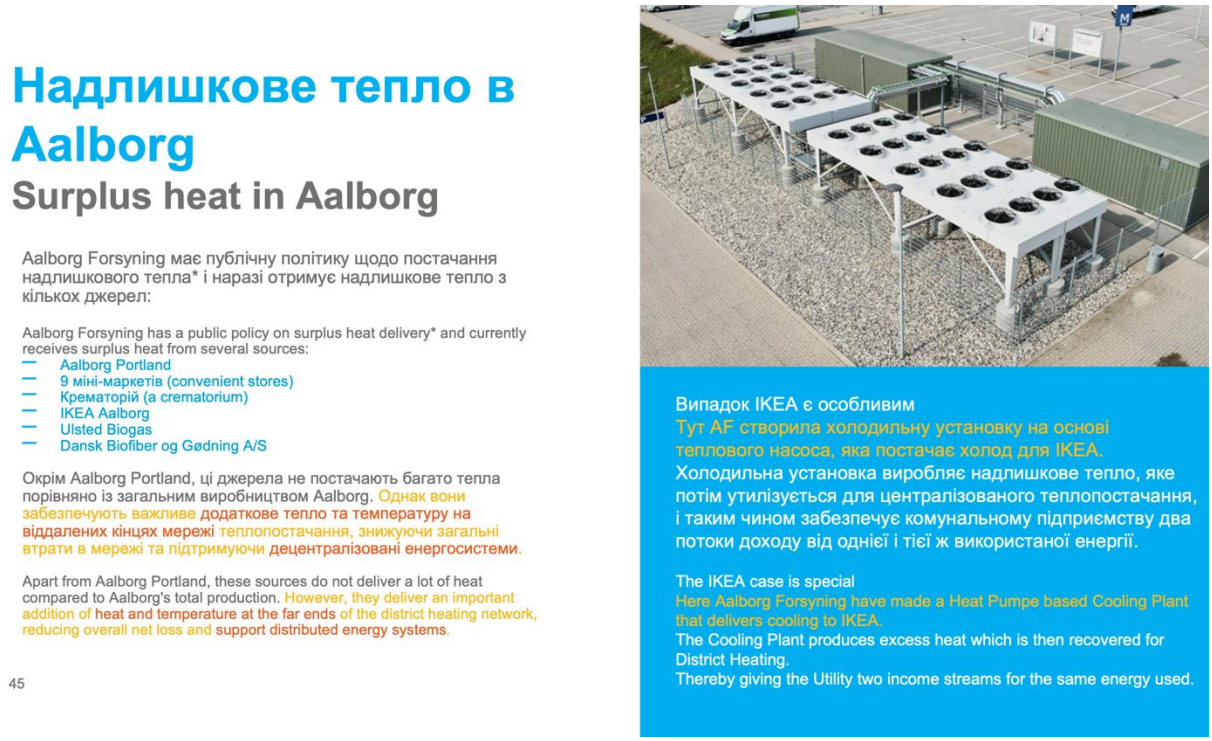


Figure 14: In the autumn of 2023 operation started on a combined cooling and heating plant delivering both cooling and heating to IKEA and surplus heat to the Aalborg DH network.

The business model creates a win-win situation: IKEA receives efficient, climate-friendly cooling and heating services at competitive prices while meeting their sustainability goals, eliminating the need for their own capital investment in cooling equipment. Aalborg Forsyning generates two distinct revenue streams from a single plant, selling cooling services to IKEA during summer while simultaneously supplying the captured surplus heat to district heating customers, and selling heat from the same equipment during winter. This transforms what would traditionally be a single-purpose cooling system into a productive asset for the district heating network. The project achieves CO2 savings of nearly 2,000 tons over six years compared to conventional cooling systems.

This case demonstrates several important principles for Ukrainian utilities considering third-party arrangements. First, the utility can strategically invest in infrastructure that creates multiple revenue streams from the same energy input. Second, smaller-scale distributed production, even when not supplying large volumes, delivers critical additional value by providing heat and temperature support at distant network endpoints, reducing overall network losses and improving system efficiency. Third, sector integration, combining heating and cooling production, opens new market opportunities beyond traditional heat supply. Aalborg Forsyning's public policy actively welcomes surplus heat from multiple sources including retail stores, a crematorium, biogas facilities, and industrial suppliers, recognizing that these distributed sources, while individually modest in scale, collectively strengthen network performance and create more resilient, decentralized energy systems.

The benefits on distributed Surplus Heat

Smaller distributed heat sources throughout a network offer strategic advantages beyond volume. Location matters as much as capacity.

Centralized systems lose heat through transmission. Distributed sources at distant endpoints reduce these losses-each megawatt injected remotely saves the equivalent energy that would be lost from the central plant.

Distributed sources also provide hydraulic support, maintaining temperatures and pressures in remote sections. This reduces burden on central pumping and stabilizes service quality for nearby consumers.

Multiple feed points create operational flexibility during disruptions. If central facilities or transmission lines fail, network sections with local surplus heat suppliers can maintain service to surrounding consumers. Individual zones can function semi-autonomously during emergencies, maintaining heat to critical facilities.

A cement plant, food processing facility, or data center becomes a local energy node serving its area. Even modest sources collectively strengthen network architecture.

Strategic location matters in surplus heat partnerships. A smaller source at a distant endpoint may deliver greater system value than a larger source adjacent to the central plant-especially when accounting for resilience and operational flexibility. Aalborg Forsyning's integration of diverse surplus heat sources across their territory demonstrates this distributed approach.

Steel to Beer: E.ON as Regional Energy Intermediary

In Duisburg, Germany, a pioneering partnership demonstrates how district heating utilities can serve as catalysts for regional industrial cooperation and resource efficiency. Since 2023, Thyssenkrupp Steel, one of Europe's largest steel producers, has supplied waste steam to König-Brauerei brewery through infrastructure built and operated by E.ON Business Solutions.[11] This cross-sector collaboration transforms what would be wasted energy into productive use while creating a model for local economic development.

E.ON's role as intermediary proved essential to the project's success. Rather than requiring the two industrial partners to negotiate and construct infrastructure directly, E.ON took responsibility for building the nearly 500-meter underground steam pipeline, installing heat exchangers, and managing ongoing energy operations. This neutral facilitator role reduced complexity, allocated risks appropriately, and enabled two companies from completely different sectors to cooperate effectively. The partnership emerged from years of discussion that had not previously materialized until E.ON structured a workable business model.

The technical solution captures just 1.5% of Thyssenkrupp Steel's integrated process steam system, yet this modest fraction covers 100% of the brewery's thermal energy requirements for brewing processes. The brewery achieved independently verified 75% CO2 emission reductions (7,300 tons annually), replacing lignite and natural gas with clean industrial surplus heat. For Thyssenkrupp Steel, the project monetizes previously wasted energy while demonstrating resource efficiency. E.ON gained a new business model demonstrating sector coupling capabilities.

[11] https://www.thyssenkrupp-steel.com/en/newsroom/press-releases/koenig-brauerei-e-on-and-thyssenkrupp-steel-to-launch-innovative-climate-protection-project.html



Figure 15: Since 2023 Thyssenkrupp Steel has supplied waste steam to König-Brauerei brewery through infrastructure built and operated by the District Heating company E.ON

While this specific installation operates as a dedicated industrial connection rather than integration with municipal district heating networks, the model applies equally to district heating systems. A utility could similarly serve as intermediary, building connecting infrastructure between industrial surplus heat sources and residential consumers, creating regional cooperation networks that strengthen local economic ties while advancing decarbonization goals. The project received funding from Germany's Federal Ministry of Economics, recognizing its pioneering role in the energy transition.

How to utilise available Surplus Heating opportunities

The previous sections have demonstrated that Ukraine possesses substantial surplus heat potential from industrial processes, with conservative estimates suggesting volumes that could meaningfully contribute to district heating supply while reducing fossil fuel dependence.

The question now shifts from “how much potential exists” to “how can this potential be realized in practice.”

This section focuses specifically on integrating surplus heat from existing industrial facilities like factories, refineries, and processing plants that currently release waste heat to the atmosphere. This differs fundamentally from other third-party access arrangements involving private investors constructing new dedicated like heating plants or combined heat and power facilities as commercial ventures. While both fall under the broader category of third-party heat supply, the commercial dynamics and risk profiles are entirely different.

Workshop discussions in December 2025 explored whether competitive procurement mechanisms, such as reverse auctions, might facilitate surplus heat integration. This approach draws inspiration from successful renewable energy procurement in the electricity sector, where competitive bidding has effectively driven down costs for wind and solar power generation. The auction model holds

intuitive appeal: district heating companies establish their own production costs as a ceiling price, and potential suppliers compete by offering lower prices.

However, the fundamental market dynamics differ significantly between electricity generation projects and industrial surplus heat utilization. Competitive bidding functions effectively when investors can develop projects at multiple potential sites; a solar or wind farm developer who loses one auction simply pursues the next opportunity. The risk-reward calculation remains viable across a portfolio of potential projects. Industrial surplus heat presents an entirely different situation: each source represents a unique, site-specific opportunity with no alternative “next project” for either party. The industrial facility cannot relocate its surplus heat elsewhere, and the district heating network cannot source identical heat from an alternative supplier at that location. This creates a bilateral monopoly situation where only direct negotiation between the two specific parties can unlock the opportunity.

International experience with surplus heat integration confirms this reality.[12] Successful projects across Europe have emerged through negotiated bilateral agreements founded on transparent cost disclosure, mutual benefit principles, and careful attention to technical integration requirements. These agreements typically apply pricing mechanisms that protect both parties' interests while ensuring consumer benefits.

A critical enabler for surplus heat utilization is removing regulatory barriers that currently discourage industrial participation particularly excessive licensing requirements and rigid tariff-setting procedures. However, district heating companies need not wait for regulatory reform to begin positioning themselves for surplus heat integration. They can initiate practical agreement and price negotiations with local industrial partners and start systematic mapping of available resources and potential business cases.

How to make agreements

Successful surplus heat integration requires carefully structured commercial agreements that balance the interests of industrial heat suppliers, district heating companies, and ultimately consumers. The negotiation process itself represents a critical foundation for long-term partnership success, as agreements must accommodate the technical complexities of heat supply while providing sufficient certainty for both parties to justify necessary investments.

The partnership between CP Kelco, a major pectin manufacturer, and VEKS, a district heating company serving 12 Danish municipalities, demonstrates how effective agreements can be structured (Figure X). After two years of negotiations characterized by transparent cost sharing and mutual respect, the parties reached agreement on a concise two-page contract (excluding all appendixes obviously). The agreement has enabled reliable heat supply that benefits all parties: CP Kelco monetizes previously wasted energy, VEKS secures cost-competitive heat supply, and consumers receive heating at lower costs than alternative production methods.

[12] https://dbdh.org/best-practice-catalogue/

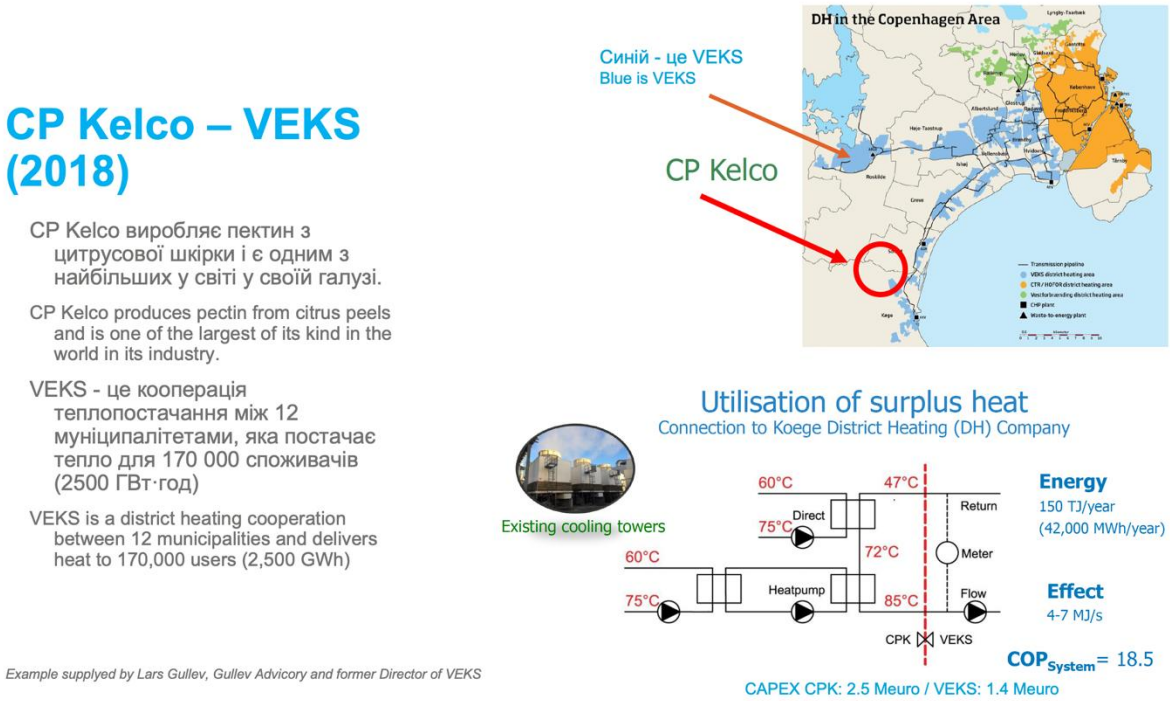


Figure 16: Example of a Surplus Heat agreement between CP Kelco and TVIS

International experience with successful surplus heat integration reveals several critical principles that raise the likelihood of reaching mutually beneficial agreements[13]:

- **Establish common goals from the outset.** Both parties should articulate shared objectives (typically reducing fossil fuel dependence, lowering costs, and contributing to climate goals,) before negotiating commercial terms.
- **Invest in relationship building and communication quality.** The CP Kelco-VEKS negotiation required two years, reflecting the complexity and the importance of building trust between organizations with different core businesses and risk perspectives.
- **Apply open book calculation principles.** The industrial supplier should disclose actual costs associated with heat extraction, treatment, and delivery (capital investments, operating expenses, maintenance). This transparency forms the foundation for fair pricing.
- **Implement the substitution principle for pricing.** The district heating company pays the lower of two calculated prices: the supplier's documented full costs (including reasonable profit) or the district heating company's own production costs for equivalent heat supply. This mechanism inherently protects consumer interests.
- **Respect each party's different interests and constraints.** Industrial facilities prioritize production continuity and cannot compromise core manufacturing processes. District heating companies require supply reliability and must maintain network stability. Successful agreements acknowledge and accommodate these distinct requirements.
- **Build mutual trust through iterative engagement.** Extended negotiation timelines should not be viewed as obstacles but as opportunities to develop understanding of each party's operational realities, risk tolerances, and decision-making processes.

[13] https://dbdh.org/best-practice-catalogue/

- **Structure agreements for operational flexibility.** Heat availability from industrial processes may vary with production schedules. Agreements should specify baseline supply expectations, procedures for communicating supply variations, and responsibilities for backup capacity.
- **Include clear technical specifications.** Define supply temperature, return temperature requirements, flow rates, heat quality parameters, and connection point responsibilities. Technical clarity prevents operational disputes.
- **Establish transparent cost-adjustment mechanisms.** Annual or periodic price reviews based on documented actual costs and updated substitution price calculations provide fair risk sharing as conditions change over time.
- **Incorporate municipal or consumer oversight.** In some European comntries, municipal approval of surplus heat projects provides democratic legitimacy and consumer confidence. Similar oversight mechanisms appropriate to Ukraine's governance structure should be considered.
- **Define investment cost-sharing principles.** Connection infrastructure (heat exchangers, pipelines, control systems) requires capital investment. Agreements should clearly allocate these costs and establish mechanisms for cost recovery, potentially including provisions for investment payback if the industrial facility ceases operation.
- **Address risk allocation for supply interruptions.** Specify responsibilities and potential compensation if the industrial supplier cannot deliver contracted heat due to facility maintenance, production changes, or closure. District heating companies must maintain backup capacity.

Pricing Mechanisms in Practice

Commercial agreements for surplus heat can take many forms, and there is no single “correct” structure. The optimal approach depends on the specific circumstances of each partnership:

- the capital investment required,
- the industrial facility's risk tolerance,
- the district heating company's financial capacity,
- the competitive landscape,
- and the urgency of securing alternative heat sources.

What matters most is that both parties perceive the arrangement as fair and that the mechanism creates mutual incentives for reliable long-term operation.

The CP Kelco-VEKS agreement illustrates one effective approach that prioritizes shared benefits through transparent calculation (Figure Y). The substitution principle provides a structured framework for determining fair pricing while protecting consumer interests. The settlement price calculation incorporates the supplier's operating costs, the district heating company's substitution price (its own production costs), and a distribution mechanism that shares the differential amount (the “savings” compared to the utility's own production) between both parties.

In this particular agreement structure, VEKS accepts a pricing arrangement that allows CP Kelco to recover its capital investment relatively quickly during the initial contract periods. From a conventional risk perspective, this places more near-term financial obligation on the district heating company.



Figure 17: Example of the agreed surplus heat pricing principle between CP Kelco and VEKS using the "substitution price calculation" as the driving factor.

However, this apparent increased risk does delivers tangible strategic benefits:

- **Securing the agreement itself.** Excessive risk aversion or demanding more favorable initial terms might have resulted in no agreement at all, leaving VEKS dependent on more expensive conventional production.
- **Immediate competitive pricing.** Even during the capital recovery period, the heat price remains competitive with VEKS' own production costs, providing immediate consumer value.
- **Pathway to very low-cost supply.** Once capital investment is recovered, heat costs decline substantially as CP Kelco's ongoing costs consist primarily of operating expenses without capital charges.
- **Protected downside risk.** The substitution principle ceiling ensures VEKS never pays more than its own production costs, regardless of CP Kelco's capital recovery schedule, keeping overall risk relatively modest.

This example demonstrates an important principle: flexibility in structuring initial terms to accommodate the supplier's investment recovery needs can unlock agreements that might otherwise fail to materialize, while still protecting the district heating company's core interests through well-designed price ceiling mechanisms. Annual reconciliation based on documented actual costs and updated substitution prices provides transparency and fair risk-sharing as operational realities evolve. Municipal approval or other, where appropriate to local governance structures, provides additional consumer safeguards and democratic legitimacy.

Other agreement structures are equally valid. Some arrangements might involve the district heating company co-financing connection infrastructure to reduce the supplier's capital burden and enable more favorable immediate pricing. Others might establish longer payback periods with more equally distributed benefits from the outset. The key is finding the particular balance that enables both parties to commit to a long-term partnership.

Systematic Resource Mapping: The Foundation for Action

Effective surplus heat integration begins with comprehensive knowledge of available resources. While many Ukrainian district heating companies already conduct some form of surplus heat awareness within their service areas, this section offers a structured framework for systematic resource assessment and economic evaluation that strengthens the business case for specific projects and facilitates productive negotiations with industrial partners.

Ukraine's Law on Energy Efficiency (No. 1818-IX, October 2021) recognizes surplus heat as a legitimate resource requiring consideration in energy planning, mandating assessment of waste heat potential including “description and map of the territory indicating existing and potential heat energy consumption facilities, existing and planned facilities in the heating sector, potential sources of thermal energy, including industrial installations or other facilities that generate waste heat energy”. As this requirement becomes increasingly incorporated into formal planning processes, utilities that have already developed robust mapping capabilities will find themselves well-positioned.

The Business Case for Comprehensive Mapping

Systematic surplus heat mapping delivers tangible value to both district heating companies and municipalities:

For utilities, comprehensive mapping transforms vague awareness of industrial facilities into concrete business intelligence. Detailed resource assessment enables credible cost-benefit analysis, supports professional negotiations with industrial partners backed by solid technical understanding, identifies multiple opportunities for portfolio development rather than single projects, and provides the analytical foundation for investment planning and regulatory approvals. The financial logic is straightforward: surplus heat procurement often delivers lower-cost heat supply than conventional production, directly improving economic performance and enabling more competitive consumer tariffs.

For municipalities, systematic assessment fulfills energy planning obligations while creating pathways toward decarbonization commitments and European Union alignment. Comprehensive information about all available heat sources within municipal jurisdiction enables evidence-based decision-making about infrastructure investments, supports climate action planning, and demonstrates responsible stewardship of municipal energy systems.

Practical Mapping Methodology

Effective resource mapping progresses through several stages, with increasing detail and value:

- **Stage 1: Initial Resource Identification (2-3 months for initial program setup; ongoing updates quarterly)**
  Begin by cataloging all industrial, commercial, and institutional facilities within and adjacent to district heating service areas with significant energy consumption. Focus particularly on energy-intensive sectors: food processing, materials production, chemical processing, metalworking, data centers, and manufacturing operations.
- **Stage 2: Preliminary Technical Assessment (1-2 months per priority opportunity cluster; 4-6 months for systematic first-pass assessment)**
  For identified facilities, gather fundamental technical parameters: estimated surplus heat volumes, temperature ranges and stability, seasonal availability patterns, etc. This stage can

often be accomplished through initial conversations with facility managers without requiring detailed technical studies.

- **Stage 3: Distance and Routing Analysis (2-4 weeks per opportunity; can run in parallel with Stage 2)**
  Calculate realistic transmission distances accounting for rights-of-way, geographical obstacles, existing infrastructure, and routing constraints. This analysis identifies which opportunities merit deeper investigation based on proximity to existing networks.
- **Stage 4: Economic Viability Through TOTEX Analysis (4-8 weeks per detailed opportunity assessment incl. dialog and meetings with industries/companies)**
  For promising opportunities, conduct Total Cost of Ownership analysis comparing surplus heat integration costs against alternative heat production options over relevant project lifetimes (typically 15-20 years). This methodology provides clear answers to the fundamental business question: “Is this opportunity financially attractive compared to our alternatives?”
- **Stage 5: Prioritization and Planning Integration (1-2 months for initial ranking; updated annually with Heat Supply Scheme revisions)**
  Rank identified opportunities based on multiple criteria: economic attractiveness (positive TOTEX comparison), technical feasibility (manageable integration complexity), environmental benefits (emissions reductions, fossil fuel displacement), strategic fit (alignment with utility development plans, portfolio diversification), and implementation readiness (willing industrial partner, clear regulatory path, available financing).
  Incorporate viable surplus heat projects into utility investment planning and municipal Heat Supply Scheme updates. Even where formal requirements do not yet mandate surplus heat assessment, voluntary inclusion demonstrates forward-thinking planning and creates the foundation for future project approvals and implementation.

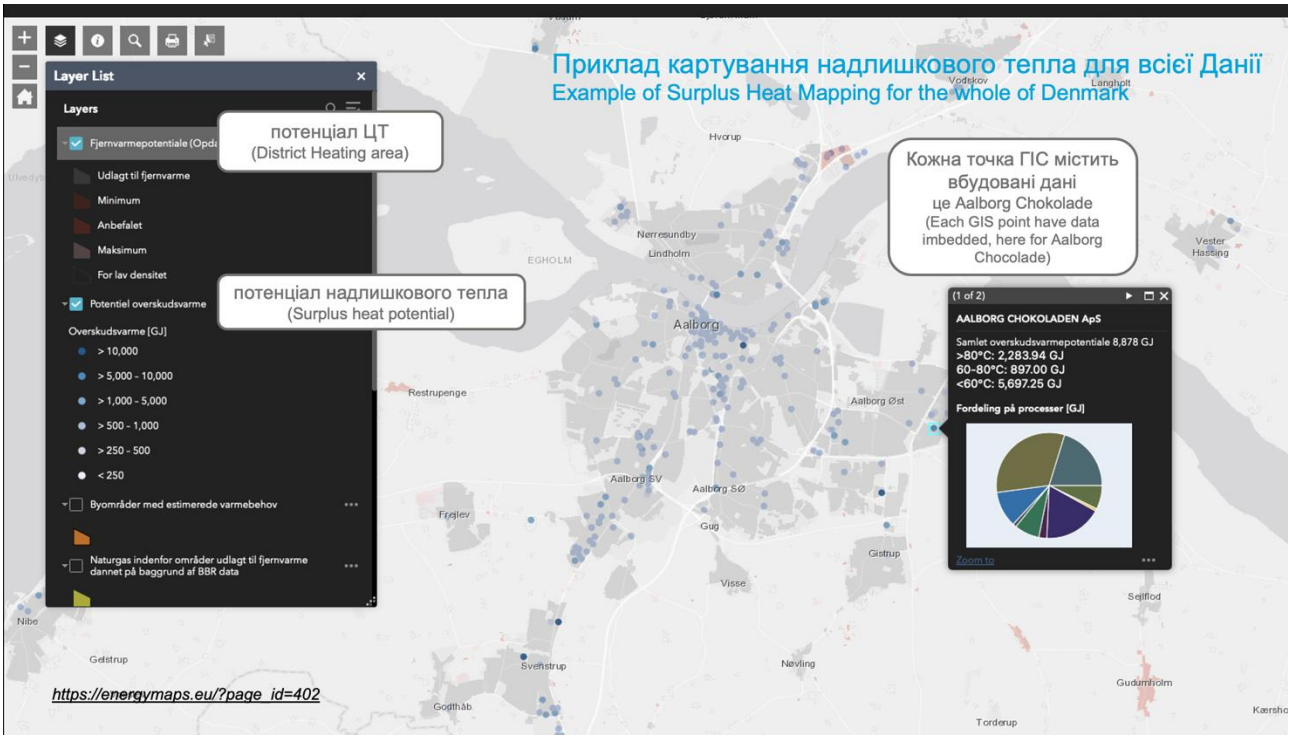


Figure 18: Example of surplus heat source mapping from Aalborg in Denmark

The benefits of TOTEX analysis

TOTEX calculations compare complete lifecycle costs of different heat supply options, accounting for both capital expenditures (CAPEX) and operating expenditures (OPEX). For surplus heat evaluation, this means comparing the total cost of connecting to and purchasing from an industrial source against the total cost of producing equivalent heat through conventional means.



	Gas Boiler		DN250 s2	
CAPEX	0,06	млн€ pr. MW	0,56	млн€ pr. km
	0,60	млн€ 10MW	11,20	20 KM
	- 0,87	млн€ 15p. (y)	- 16,19	млн€ 15p. (y)
OPEX	105	% efficiency	95	% efficiency
	571	GWh	632	GWh
	38,56*	€ pr. MWh	9,64**	€ pr. MWh
	- 22,03	млн€ 15p. (y)	- 6,09	млн€ 15p. (y)
TOTEX	- 22,90	млн€	- 22,27	млн€

Figure 19: A simplyfied TOTEX comparison of a new gas boiler and and DH transmissionline.

Figure 19 illustrates a simplified TOTEX comparison examining a specific question: how far can transmission infrastructure economically extend while maintaining cost-competitiveness? The example compares two scenarios over 15 years: installing a new 10 MW natural gas boiler versus constructing a DN250 transmission pipeline to connect with a private combined heat and power plant.

- **Gas boiler option**: Capital costs include equipment and installation (€0.6 million for 10 MW capacity). Operating costs over 15 years, assuming 4,000 hours annual operation and 105% efficiency, total approximately €22 million at average 2024 market gas prices. Total TOTEX: €22.9 million.
- **Transmission pipeline option**: Capital costs scale with distance (€0.56 million per kilometer for DN250 diameter). Operating costs over 15 years reflect the price differential between CHP gas prices and heat-only production gas prices – approximately €9.64 per MWh difference. At 20 kilometers transmission distance, capital costs reach €11.2 million, while operating cost savings total €16.2 million. Total TOTEX: €22.3 million.

This simplified calculation illustrates that when applying TOTEX methodology, potentially feasible sources of surplus heat may well be located further away than initially assumed. The substitution price principle, comparing total connection costs against the utility's own production costs, provides a systematic framework for evaluating which opportunities to go for.

In this study we focus on three practical approaches to successful surplus heat integration:

- negotiated agreements based on open cost calculations and shared benefits,
- systematic resource mapping that identifies real opportunities,
- and TOTEX analysis that validates economic viability.

Utilities could implement these approaches today as the tools, methodologies, and business models exist and have been proven internationally.

Regulatory framework improvements will come but waiting offers little advantage. Early-mover utilities gain experience understanding industrial partner needs, refining economic models, and building technical integration expertise that competitors cannot replicate.

The following section consolidates recommendations addressing both the immediate actions within your control and the regulatory reforms that will accelerate surplus heat utilization across Ukraine's district heating sector.

Consolidated Recommendations

Recommendations for DISTRICT HEATING UTILITIES

1. Reduce heat production costs through waste heat recovery and Third-Party Access with cheaper generation technologies

In collaboration with municipal authorities, conduct a formal assessment of waste heat potential from nearby industrial facilities. Create a supportive regulatory and technical environment for connecting these sources to the DH networks, offering industry partners long-term, mutually beneficial agreements for waste heat off-take.

Facilitate the connection of heat producers utilizing renewable energy sources. Offer long-term heat purchase agreements to private developers on competitive terms.

Attract investment into cogeneration units. This will not only provide lower-cost heat energy but also ensure decentralized power resilience for the boiler house equipment during grid outages or “blackouts”.

2. Minimize heat losses and power consumption when heat carrier transporting.

Make the heat network optimization and modernisation. Prioritize the comprehensive replacement of heat networks within specific thermo-hydraulic clusters. Optimize pipe diameters (right-sizing) to match current and projected heat loads.

Modernize pumping stations with the frequency converters installation and optimize hydraulic regimes to minimize the specific electricity consumption required for heat distribution.

Implement network looping or interconnecting where technically feasible.

3. Implement Digitalization and Energy Management

Execute a phased rollout of SCADA system. Establish an energy management system within the utility to monitor KPIs, identify inefficiencies, and drive continuous operational improvement.

4. Heat load re-densification

Develop measures to encourage apartments in multi-apartment buildings that previously disconnected to rejoin the DH network. Increasing heat load density is essential for improving the overall DH system efficiency.

5. Assess feasibility restoring centralized hot water supply.

As heat production costs decrease and retail electricity prices rise for the population, centralized hot water supply may become more cost-effective for consumers than individual electric water boilers.

Where feasible, install Individual Heat Substations (IHSs) with integrated hot water preparation capabilities.

6. Implementation of two-rate tariffs

Adopting a two-rate tariff (comprising a fixed capacity charge and a variable energy charge) will ensure steady cash flow for the utility during the non-heating season, allowing for consistent planned maintenance.

For the end-user, this structure levels out energy expenditure throughout the year and reduces the financial “peak” of utility bills during the winter months. This also enables the decoupling of utility pricing from social support mechanisms allowing targeted subsidies to vulnerable households instead of price suppression.

7. Develop the DH systems modernization roadmap

All modernization initiatives must be consolidated into a comprehensive Strategic Development Plan. This document should outline clear objectives, measurable KPIs, and be formally ratified by the municipal government.

The DH utilities should initiate Municipal energy planning that should include Heat Mapping part.

Intensify activities closely with the municipality to attract investments for the implementation of the measures specified in the document.

Recommendations for POLICY MAKERS

Ukraine's district heating sector stands at a critical juncture, requiring comprehensive legislative reform to meet both European Union accession requirements and urgent domestic energy security needs. The ongoing war has highlighted the vulnerability of centralized heating systems dependent on imported natural gas, while simultaneously creating opportunities for modernization through international support and EU integration processes.

Recent comprehensive studies by the Danish Energy Agency, USAID, and Green Deal Ukraine have been used as a backdrop for this study.

In this chapter we provided a summary of relevant policy recommendations from these studies coupled with own findings from this study.

Primary sources:

- DEA R1 2024: “Technical Support for the Preparation of the New Edition of the Ukrainian Law on Heat Supply - Part I” (June 2024)
- DEA R2 2024: “Technical Support for the Preparation of the New Edition of the Ukrainian Law on Heat Supply - Part II” (December 2024)
- USAID 2020: “District Heating Policy Assessment and Recommendations White Paper” (August 2020)
- Green Deal Ukraine 2025: “Municipal Heat Supply Status Report” (May 2025)
- This UNICEF Ukrainian DH study 2026

1. Establish Third-Party Access Framework with Connection Rights and Purchase Obligations

Green Deal Ukraine identifies that Ukraine lacks regulatory frameworks for third-party energy input into district heating networks, with no established procedures or incentives for independent producers to supply heat. USAID emphasizes establishing favorable conditions for CHP, renewable energy, and waste heat utilization, yet current regulations provide no clear integration pathways.

The UNICEF Ukrainian DH study provides some validation: two out of the five cities studied had successfully attracted third-party heat suppliers, however the opportunity for industrial waste heat and renewable energy development is present at all locations. Utility managers cited unclear connection procedures and commercial frameworks as primary obstacles. The study identifies a trust gap between industrial suppliers (eg. seeking <3-year payback) and utilities (eg. requiring TOTEX competitiveness), with no regulatory framework bridging this through standardized procedures.

Recommendation 1: Develop and implement legislation establishing third-party access procedures for district heating networks.

This framework should include:

- Transparent, non-discriminatory connection procedures with defined technical requirements, standardized timelines (e.g., 10 days for technical specifications), and objective cost allocation.
- Statutory heat purchase obligations requiring utilities to accept third-party heat when its price is below the variable cost of utility's own production (the substitution price), with priority dispatch based on merit order (lowest marginal cost first).
- Examples of heat purchase agreement templates e.g. specifying minimum offtake volumes, pricing mechanisms, payment terms, and force majeure provisions.
- Mechanism for independent oversight by NEURC including dispute resolution mechanisms.
- Clear definition of technical requirements for heat quality (temperature, pressure, cleanliness) with utility responsibility for overall system balancing and consumer supply quality;
- Requirement for utilities to maintain transparent real-time data on network capacity, heat demand forecasts, and available connection points.

Source Reference

Green Deal Ukraine Status Report, Section on “Sector Coupling and Third-Party Access”: “Another key barrier to advancing sector coupling in Ukraine is the lack of a clear regulatory framework for third-party energy input into district heating networks. Ukraine's DH sector is dominated by municipal utilities that often operate as natural monopolies in each city, with exclusive control over both heat production and infrastructure. As a result, there are no established procedures or incentives for independent producers – such as industrial facilities with waste heat, or private cogeneration units – to supply heat to city systems.”

USAID District Heating White Paper, Section 3.3 “Summary of Recommended Actions”: “Establish favorable regulatory conditions for utilization of combined heat and power (CHP) plants, renewable energy, and waste heat sources.”

Example: **UNICEF Ukrainian DH Study**, Workshop Presentation: Investment conditions assessment shows “Market Access” rated yellow (partly fulfilled): “monopolistic operators lacking incentives and mandates for third-party access.”

2. Streamline Permitting and Licensing for Third-Party Heat Suppliers

The Danish Energy Agency identifies streamlined permitting and transparent regulations as essential to minimize uncertainty and attract investment, emphasizing adherence to international standards and best practices for EU alignment. USAID emphasizes consolidated regulations with clearly defined regulatory rights and responsibilities.

The UNICEF Ukrainian DH study documents excessive licensing requirements creating barriers: industrial enterprises must obtain heat production licenses, calculate and approve tariffs, and comply with numerous procedures despite no purchase guarantee and no sanctions for venting waste heat. Zero successful industrial waste heat integration across five cities directly reflects these procedural obstacles.

Recommendation 2: Exempt third-party heat suppliers from heat production licensing and individual tariff approval requirements when selling exclusively to licensed district heating companies for further distribution to end consumers.

Instead, establish a simplified notification and technical registration system requiring only:

- Demonstration of technical capability to meet heat quality standards (temperature, pressure, cleanliness);
- Basic safety and environmental compliance certification;
- Connection agreement with the licensed district heating utility.

Place the responsibility for heat quality, system balancing, consumer service standards, and tariff compliance on the licensed district heating company purchasing and distributing the heat.

For waste heat pricing, allow free negotiation between suppliers and utilities with a regulatory ceiling set at the substitution cost of the utility's approved production tariff, ensuring waste heat remains economically attractive compared to the utilities existing or planned alternatives.

Establish fast-track environmental permitting for waste heat recovery projects (maximum 60-day approval) since they represent environmental improvements rather than new pollution sources. This approach maintains consumer protection and system oversight while dramatically reducing barriers for non-core heat producers to participate in district heating modernization.

Source Reference

Danish Energy Agency (DEA) Report R1, Section 5.5.2 “Strengthening the investment environment around the district heating sector”: “Streamlined permitting processes to reduce bureaucratic hurdles, and transparent regulations: clear guidelines and predictable outcomes are essential to minimize uncertainty, attract investment, and facilitate public-private partnerships. This includes: Adherence to international standards and adoption of best practices in regulatory and policy frameworks.”

USAID District Heating White Paper, Section 3.3: “Consolidate NEURC and MinRegion regulations so that there is a single fair and consistent set of rules. Clearly define regulatory rights and responsibilities of central and local authorities in DH regulation.”

UNICEF Ukrainian DH Study, Workshop: “Recommendations for legislators – Create transparent rules for heat purchase and network connection; Allow for free negotiation between TPAs [Third Party Access] and DHCs [District Heating Companies]; Allow for total cost of ownership (TOTEX) and substitutions price calculation.”

3. Mandate Industrial Waste Heat Potential Assessment in Heat Supply Schemes

The Danish Energy Agency identifies Ukraine's significant potential for utilizing industrial and data center waste heat to improve efficiency and reduce emissions, noting challenges include lack of regulatory/contractual frameworks, pricing uncertainties, and ownership barriers between private industry and municipal utilities. Success requires fair pricing mechanisms and clear guidelines.

The UNICEF Ukrainian DH study documents that none of the cities studied had conducted structured supply/waste heat potential assessments during Heat Supply Scheme development. For example Kropyvnytskyi's 2023-2032 Heat Supply Scheme, limited its scope to investigate sunflower husks as fuel only, despite the city hosting major industrial facilities potentially generating substantial waste heat volumes.

Recommendation 3: Amend the Methodology for Development of Heat Supply Schemes to require mandatory assessment of industrial waste heat potential within all district heating service areas.

Requirements could include:

- Identification and mapping of all industrial facilities, data centers, and other energy-intensive operations with waste heat above 1 MW thermal capacity.
- Quantitative assessment of available waste heat including temperature levels, annual and seasonal availability profiles, and thermal quality parameters.
- Prioritization framework ranking opportunities based on cost-effectiveness, environmental benefits, and proximity to existing infrastructure. For the best opportunities;
  - Preliminary technical feasibility analysis addressing integration requirements (distance to existing networks, necessary heat exchangers, temperature matching).
  - Economic assessment comparing costs of waste heat integration against alternative heat sources on a total cost of ownership (TOTEX) basis.
- Incorporation of viable waste heat projects into mandatory 10-year development plans.
- Standardized assessment templates and methodologies ensuring consistency across municipalities.
- Mandatory updates every 3 years to capture new industrial developments and changing heat load patterns.

Source Reference

Danish Energy Agency (DEA) Report R2, Section 4 “Promotion of Cost-Effective and Sustainable Heat Supply”: “District heating has the potential to utilize excess heat from energy-intensive industries and from future data centers by storing the waste heat in hot water accumulators or using it directly, which will overall improve energy efficiency and reduce emissions. However, utilization of excess industrial heat in Ukraine can have several technical, economic, and legal challenges: It can be a challenge to ensure fair and stable pricing for excess heat, i.e. clear regulatory and contractual frameworks are lacking.”

UNICEF Ukrainian DH Study, Section “Experience in Waste Heat Utilization”: “Among the cities studied, none had conducted a waste heat potential assessment during the development of their municipal Heat Supply Schemes. Only Vinnytsia has recently included a requirement of waste heat assessment in the Terms of Reference for the Heat Supply Scheme updating in 2026. The main reasons for the lack of examples of industrial waste heat integration in DH systems in Ukraine include: A lack clear requirements for Heat Supply Scheme developers on mandatory conduction of waste heat potential assessment.”

4. Establish Mandatory Investment Program Implementation with Protected Funding

The Danish Energy Agency identifies investment programs as mandatory tariff components requiring effective financing mechanisms, emphasizing that diversion to operational deficits negates regulatory approval. DEA notes large investments require favorable loan terms reflecting system lifespans.

The UNICEF Ukrainian DH study illustrate a very fractured and diverse implementation to investment planning and implementation between the different municipalities.

Recommendation 4: Establish statutory requirements for investment program implementation with protected funding mechanisms preventing diversion to operational expenditures.

Create mandatory “ring-fenced” accounts for investment program funds operating similar to escrow arrangements and impose long term investment planning (3-5 years):

- Require utilities to deposit investment components of approved tariffs into dedicated accounts held by independent financial institutions, with funds accessible only for approved investment projects.
- Mandate that state tariff compensation payments prioritize investment program funding before operational subsidies – compensation should first satisfy investment account requirements, with remaining amounts available for operations.
- Establish separate municipal budget mechanisms for emergency operational support rather than allowing utilities to raid investment funds during cash flow crises.
- Require utilities to demonstrate achievement of minimum 70% implementation of approved investment programs over three-year periods, with regulatory review for programs falling below this threshold to identify systemic barriers (force majeure, supply chain constraints, regulatory delays) requiring remedial support rather than sanctions.
- Mandate that unused investment funds be either refunded to consumers through tariff adjustments in subsequent periods or rolled forward with accrued interest to expanded investment programs, maintaining transparency through public reporting.
- For private investors participating in utility build up through PPPs or third-party arrangements, establish mechanism that enables safe and transparent use of investment program funds to cooperate on these joint activities.
- Require investment program reporting transparency including quarterly public disclosure of fund deposits, expenditures, and project implementation status to enable stakeholder and regulator monitoring.

Source Reference

Danish Energy Agency (DEA) Report R1, Section 5.5.1: “Supportive Rules for Depreciation of Investments: Establishing rules that allow for favorable depreciation rates on investments to encourage modernization and efficiency improvements… National Debt Restructuring Program: Creating a program to assist district heating companies in restructuring existing debt to improve financial stability and attract new investments.”

UNICEF Ukrainian DH Study, Odesa Financial Status: “Between 2021 and 2023, the enterprise had zero capital for investment activities within its tariff structure. In 2024, less than UAH 3 million was utilized for investment out of the UAH 30 million originally planned.”

5. Implement Statutory Two Rate Tariff Structure with Cost Recovery

The Danish Energy Agency assessment identifies that single rate variable tariffs create liquidity risk. In addition, it contradicts EU Energy Efficiency Directive requiring cost-reflective pricing to separating fixed and variable costs. One rate structure also makes the effect of efficiency improvements and the total cost of investment less clear.

Recommendation 5: Mandate by law a statutory to use the two-rate tariff structure for all district heating services.

The tariff must comprise:

- A fixed component covering network infrastructure, fixed operational costs, and depreciation, calculated per square meter of heated area or per connection capacity; and
- A variable component covering fuel and consumption-dependent costs, based on metered heat consumption.

Implement this structure uniformly across all regulatory jurisdictions (NEURC licensees, regional administrations, and municipal authorities) to ensure consistent investment conditions nationwide.

Establish statutory tariff adequacy requirements ensuring that approved tariffs cover all economically justified costs, including mandatory investment program components, with automatic adjustment mechanisms when input costs change significantly (as required for gas market liberalization).

Source Reference

Danish Energy Agency (DEA) Report R1, Section 5.5.1 “Strengthening the financial resilience of district heating companies”: “The 1-tier tariff structure, i.e., use of a fully variable tariff is recommended to be banned, as it can create a large liquidity risk for the district heating company, if the heat sale fails, because it leads to an under coverage of all the fixed costs that the district heating company has. When dealing with high old debts the Ukrainian district heating companies are very vulnerable to a fully variable district heating tariff.”

UNICEF Ukrainian DH Study, Financial Status Odesa: “The heat tariff for the residential sector has remained unchanged since 2021 at 1,511.62 UAH/Gcal. This covers only 62% of the economically justified tariff established for the enterprise for 2025. By the end of 2024, the uncompensated tariff deficit owed by the state to “Teplopostachannya mista Odesy” stood at UAH 1.8 billion, rising to UAH 2.1 billion in 2025 - an amount nearly equal to the utility's total annual revenue from heat sales.”

6. Establish Unified National Framework with Local Implementation and Central Oversight

Green Deal Ukraine documents regulatory fragmentation across NEURC and local governments (further subdivided among regional administrations and councils), creating overlapping responsibilities and investment barriers. Fragmentation spans licensing (three-tier system by utility size), tariff setting (different methodologies by jurisdiction), investment approval (varying procedures and timelines), and compliance monitoring (inconsistent enforcement).

USAID emphasizes transparent, rules-based systems require consolidation for sector stability. The UNICEF Ukrainian DH study demonstrates practical impacts: utilities under different jurisdictions face vastly different investment capabilities despite similar needs, forcing investors to develop jurisdiction-specific strategies rather than scalable national approaches.

Recommendation 6: Establish a unified national framework where municipalities hold primary approval authority following mandatory national methodologies, with central oversight ensuring consistency and providing appeals mechanisms.

Specifically it could be considered to:

- Create national templates for third-party access including connection requirements, heat purchase agreement frameworks, technical standards, and pricing principles that municipalities implement locally.
- Establish central appeals mechanism allowing utilities, third-party suppliers, or investors to challenge municipal decisions to NEURC (or designated body).
- Establish central technical support unit providing municipalities with training, guidance materials, and expert consultation to build capacity for implementing national methodologies consistently.

Source Reference

Green Deal Ukraine Status Report, Section on regulatory framework: “These legislative packages define the division of powers to regulate the heat supply sector between the Regulator and local governments, which in turn also divide the powers among themselves, regional state administrations, and local councils (executive bodies of city, town, and village councils). These complex and imperfect state regulations with overlapping responsibilities creates barriers for investments in the heating sector.”

USAID District Heating White Paper, Section 2.2.2: “A transparent, rules-based DH regulatory system is important to stabilizing the sector... the priority in the near-term should be on building robust regulatory expertise and streamlining regulations so that there is one common and consistent set of regulations across the country.”

Danish Energy Agency (DEA) Report R1, Section on Danish regulatory framework: Danish municipalities hold primary approval authority for district heating projects under national frameworks established by the Danish Energy Agency, with decisions subject to appeal to the Danish Energy Board of Appeal. This structure combines local responsiveness with national consistency, enabling faster project execution while maintaining investor predictability through unified methodologies and oversight mechanisms.

7. Separate Social Protection from District Heating Tariff Regulation

The Danish Energy Agency identifies that tariff suppression as a social support mechanism creates chronic financial deficits, infrastructure deterioration, and barriers to private investment. DEA R2 emphasizes that Ukrainian legislation on tariffs must separate social policy from heat tariff regulation to establish cost-reflective pricing while protecting vulnerable consumers.

USAID documents that current Ukrainian energy prices remain 60-80% below EU levels through approximately €4.7 billion/235 billion UAH in annual subsidies. The OECD analysis referenced in the USAID White Paper demonstrates successful European models where district heating tariffs reflect full costs while targeted government subsidies protect vulnerable households.

The UNICEF Ukrainian DH study documents consequences: Odesa DHC receives 500 million UAH annual municipal subsidy, yet tariffs cover only 62% of economically justified costs, creating unsustainable financial conditions regardless of subsidy levels. Zero successful private investment in surplus heat integration across five cities studied directly reflects investors' inability to negotiate viable returns under suppressed tariff regimes.

Recommendation 7: Mandate separation of social protection from district heating tariff regulation through legislative amendments establishing cost-reflective tariffs alongside targeted household subsidies.

Specifically:

- **Tariff regulation focus exclusively on:** Cost transparency through mandatory TOTEX methodology, operational efficiency through comparative benchmarking, prevention of monopolistic pricing through substitution price ceilings, and full recovery of economically justified costs including investment program components.
- **Social protection administered separately through:** Direct government subsidy programs covering the difference between actual heating bills and household affordability thresholds (10-15% of monthly income as currently defined), with eligibility determined by Ministry of Social Policy rather than energy regulators.
- **Implementation mechanism:** Households pay full cost-reflective tariffs to utilities (ensuring utilities receive proper revenue for investment and maintenance); government reimburses qualifying households through existing housing subsidy system expanded to cover cost-reflective heating bills; utilities report transparent cost structures enabling proper subsidy calculation.
- **Transition support:** Temporary crisis supports measures during tariff adjustment period, including lump-sum payments (e.g., Denmark's Heat Check model) and expanded eligibility criteria for existing housing subsidy programs to cushion initial impact.
- **Integration with efficiency investments:** Combine immediate bill coverage with long-term energy efficiency programs (building insulation, heating system modernization, district heating connections) that reduce future subsidy needs while improving housing stock quality.

Source Reference

Danish Energy Agency (DEA) Report R2, Section 2.1.1 “Separating social policy from heat tariff regulation”: “It is recommended that Ukrainian legislation on tariffs be amended with a focus on the following: Separating social policy from heat tariff regulation.” The report emphasizes that cost-reflective tariffs enable utility sustainability while targeted social subsidies protect vulnerable households.

USAID District Heating White Paper, Section 3.2.1 “Tariffs, Payment Discipline, and Governance”: The OECD analysis demonstrates European models where “social protection for vulnerable households can be administered through targeted government subsidy programs that cover the difference between actual heating bills and what households can afford to pay.”

UNICEF Ukrainian DH Study, Financial Status Odesa: Current system creates “state compensation debt of 2.1 billion UAH exceeding annual heat revenue” while failing to enable proper investment. Workshop consensus: “Finance operational costs from tariffs, not municipal budgets” combined with separate social protection mechanisms.

European best practice examples: Denmark's Heat Check (lump-sum to 400,000+ households), UK's Warm Home Discount (data-driven automatic enrollment combining income and dwelling efficiency), Germany's targeted heating assistance (up to 100% reimbursement for vulnerable households), and Poland's Stop Smog Programme (100% financing for heating replacement and efficiency improvements totaling €265 million/13.25 billion UAH).

Model	Payment Timing	Administration	Used In	Best For
Lump-Sum	Periodic/one-time	Simple	Denmark, Austria, Cyprus, Poland	Quick deployment, household flexibility
Bill Coverage - Before Payment	Automatic discount	Utility-administered	United Kingdom, Belgium, Netherlands, Spain	High take-up, seamless experience
Bill Coverage - After Payment	Reimbursement	Government-administered	Germany, Romania, France	Investment-friendly, transparent pricing
Welfare Extension	Integrated benefits	Existing welfare system	Sweden, Denmark, Netherlands, Germany	Simplicity, avoiding stigma
Combined Programs	Investment + support	Complex multi-agency	France, Ireland, Poland, Slovakia, Spain	Long-term structural solution
Emergency Tool	Crisis-dependent	Multiple channels	France, Germany, Belgium, Denmark, Poland	Transition periods, price shocks

Table 4: Overview of social protection model exampels from across the EU

Implementation of recommendation

All six recommendations should be pursued simultaneously rather than sequentially. The numbered order reflects priority assessment based on impact potential and stakeholder feedback, but Ukraine's urgent energy security needs and EU accession timeline require parallel action across all reform areas.

Implementation Characteristics by Recommendation

The recommendations vary in implementation complexity and timeline:

Quick Implementation Pathway (6-12 months):

- **Recommendation 3** (Waste heat assessments): Low-cost desk studies that can be incorporated into ongoing Heat Supply Scheme updates. Requires methodology guidance and template development, not new legislation.
- **Recommendation 2** (Streamlined licensing): Primarily requires NEURC regulatory changes and guidance documents. Can be implemented through administrative procedures without primary legislation.

Moderate Implementation Pathway (12-24 months):

- **Recommendation 1** (Third-party access framework): Requires legislative amendments establishing connection rights and purchase obligations. Template development and dispute resolution mechanisms need institutional setup.
- **Recommendation 4** (Protected investment funds): Requires coordination between NEURC, Ministry of Finance, and municipalities to establish ring-fenced accounting systems and budget mechanisms.

Complex Implementation Pathway (18-36 months):

- **Recommendation 5** (Two-rate tariff structure): Requires statutory mandate, methodology revision across all regulatory jurisdictions, and utility accounting system upgrades. Must be coordinated with broader tariff adequacy reforms.
- **Recommendation 6** (Unified national framework): Requires substantial institutional capacity building, coordination across government levels, and establishment of central support and appeals mechanisms.
- **Recommendation 7** (Separate social protection from tariff regulation): Requires legislative amendments across multiple laws (heat supply, social protection), coordination between NEURC and Ministry of Social Policy, and expansion of housing subsidy administration systems. Must be implemented in parallel with tariff adequacy reforms to ensure vulnerable households remain protected during transition to cost-reflective pricing.

Complementary Actions

These recommendations address regulatory and procedural barriers but require complementary actions for full effectiveness:

- Removal of residential heating tariff caps to enable cost recovery
- State budget mechanisms ensuring timely compensation payments
- Technical assistance programs building municipal and utility capacity
- Financing instruments (guarantee schemes, concessional lending) de-risking private investment
- Public awareness campaigns explaining benefits of sector modernization

Alignment with EU Accession and Post-War Reconstruction

These reform suggestions address Ukraine's energy security, EU accession requirements, and reconstruction financing needs. Overall, the suggestions align with the EU Energy Efficiency Directive while creating investment conditions for sector modernization. DEA, USAID, and Green Deal Ukraine provide international evidence that comprehensive reforms can transform district heating while the UNICEF study provides Ukrainian evidence of current barriers and post-reform opportunities.

Discussion

Workshop discussions in December 2025 revealed strong stakeholder preference for competitive auction mechanisms, reflecting legitimate concerns about transparency and accountability in Ukraine's district heating sector. Participants emphasized that automated bidding systems could eliminate corruption risks and align Ukrainian practice with EU market liberalization principles. In Lithuania a auction model, operating through the BALTPOOL platform that already partners with Ukraine's Bioenergy Association, appeared to offer a potential template.

However, international experience demonstrates that successful surplus heat integration follows multiple pathways depending on local context, institutional capacity, and implementation timelines. Danish utilities have achieved substantial industrial waste heat integration through negotiated bilateral contracts rather than competitive procurement; the Baltic states spent over a decade building the complete ecosystem for their auction mechanism.

Ukrainian municipalities face immediate opportunities to integrate available industrial waste heat from steel plants, food processing facilities, and chemical manufacturers – surplus heat that exists today but remains disconnected from district heating networks.

How can Ukraine integrate maximum available surplus heat as quickly as possible while maintaining regulatory oversight and transparency?

The Baltic Competitive Auction Model

In Lithuania they have created a competitive heat auction as a procurement system where the district heating network operator functions as a neutral buyer obligated to purchase heat from multiple competing producers based on price ranking. It creates an open marketplace where any qualified producer, whether the utility's own facilities, private biomass plants, industrial waste heat sources, or renewable energy installations, can supply heat to the network. Lithuania's Kaunas system, operated by JSC Kauno Energija (KE), exemplifies this structure.

The auction operates through monthly procurement cycles with one-month forward delivery. Each month, all heat producers connected to or seeking connection to the city's district heating network submit digital bids to the BALTPOOL exchange platform. These bids specify available capacity (MWh), offered price (EUR/MWh), and sustainability credentials. The bidding window closes on a predetermined date, typically mid-month for the following month's supply.

Once bidding closes, the BALTPOOL system automatically ranks all proposals according to a merit-order dispatch algorithm that considers both price and sustainability performance. The network operator faces a legal obligation to purchase heat strictly according to this automated ranking, with no discretion to favor particular suppliers or override the algorithm's output. The merit order prioritizes the combination of lowest price and highest sustainability (primarily CO_2 emissions intensity, renewable fuel content, and energy efficiency), ensuring that both economic and environmental objectives are optimized. Procurement begins with the top-ranked producer and progresses down the merit order until forecast demand is satisfied.

In Kaunas, 13 distinct entities participate in monthly bidding, including KE's own 590 MW production capacity, private biomass CHP operators, waste-to-energy facilities, and industrial surplus heat

providers. Third-party producers supplied 71% of Kaunas' total heat in 2024, demonstrating that competition is genuine rather than theoretical. Natural gas-fired plants, once dominant, now operate only during extreme cold periods when cheaper renewable capacity is fully utilized. All auction results are posted publicly, creating full transparency and eliminating opportunities for preferential treatment or backdoor negotiations.

Prerequisites for the Baltic heat auctioning system

Successful auction operation requires multiple elements functioning simultaneously:

- *Legal and regulatory framework:* National legislation mandating merit-order purchase eliminates utility discretion. An independent regulatory authority (Lithuania's NERC) enforces compliance, investigates disputes, and penalizes violations. Without legal obligation, utilities retain de facto control and can block competitive procurement.
- *Digital infrastructure:* The BALTPOOL exchange platform provides automated bidding, merit-order ranking, settlement, and public results posting. Manual or paper-based systems cannot achieve necessary transparency and speed.
- *Integrated fuel markets:* Competitive heat production requires liquid fuel markets. BALTPOOL's parallel biomass exchange hosts 251 suppliers and 100+ buyers, enabling producers to source wood chips, pellets, and agricultural residues at transparent market prices. Without fuel market integration, producers face procurement uncertainty that limits competitive bidding ability.
- *Producer diversity:* Genuine price discovery requires minimum 3-5 competing entities; single or duopoly suppliers cannot create market dynamics. Kaunas' 13 monthly bidders include varied technologies and ownership structures.
- *Favorable renewable economics:* In Lithuania, locally-sourced biomass and waste-derived fuels consistently undercut natural gas prices, creating economic incentive for renewable investment. If fossil fuels remain cheapest, auctions may lock in carbon-intensive supply.
- *Institutional capacity:* Regulatory oversight demands technical expertise to monitor compliance, assess technical bids, resolve disputes, and update methodologies as markets evolve.

Lithuania developed its current system over more than a decade following BALTPOOL's 2013 establishment, with full auction maturity achieved through the 2020s. The system required sustained political commitment, institutional capacity building, biomass market development, and legislative refinement across multiple election cycles.

Implementation timeline for Ukraine

Theoretical Ukrainian timeline: 2-7 years – existing legislation may be used; Years 0-2 for legislative reform and pilot preparation; Years 2-4 for pilot auction launch and regulatory capacity development; Years 4-7 for national mainstream rollout to additional cities. This assumes sustained institutional support, adequate financing, and absence of major disruptions.

Current Ukrainian barrier: Existing legislation references “competitive tender” for multiple heat producers but provides no implementation procedure. Private producers are restricted to selling at regulator-approved tariffs rather than market-determined prices, making price-based competitive auctions legally impossible without legislative reform.

Documented outcomes: Kaunas achieved 35% price reduction over five years, with average heat prices around 5 ct/kWh. Automated transparency eliminated corruption risks. Rapid fuel diversification displaced natural gas from primary to backup role, enhancing energy security while reducing carbon emissions.

Bilateral Agreement Frameworks

Between competitive auctions and unstructured private deals lies a spectrum of bilateral agreement frameworks:

State-Defined Frame: Government establishes standardized contract terms, pricing formulas, and technical requirements applicable to all surplus heat agreements. Utilities and suppliers negotiate within these fixed parameters. Pricing formula typically references regulatory tariff components or fuel substitution costs. All agreements follow identical structure with limited flexibility.

Example: National decree specifying maximum surplus heat price as 85% of utility's approved gas boiler tariff, with mandatory 15-year contract duration and predefined force majeure clauses.

Structured Negotiation: Regulatory authority approves pricing methodology and contract frameworks, but parties negotiate project-specific terms within these boundaries. Price bounded by utility substitution cost (ceiling) and supplier production cost (floor). Standardized contract templates address key terms while accommodating project variations.

Example: Danish “Business Partnership Contract” model – TOTEX methodology approved by regulator, but CP Kelco and VEKS negotiated specific price (between substitution cost and production cost), connection investment allocation, and operational parameters for their unique industrial waste heat project.

Free Negotiation: Parties negotiate all terms privately with minimal regulatory guidance. No standardized methodology, pricing boundaries, or contract templates. Utility and supplier determine price, duration, technical specifications, and commercial terms through direct bargaining.

Completely free negotiation offers both freedom and speed but also risks as vulnerability for corruption, a lack of consumer protection and no share learning across deals. With the Ukrainian governance context and workshop participants' emphasis on transparency we will leave out unstructured bilateral agreements in the following discussion.

Comparison of Heat Procurement Approaches

From the above we have three procurement mechanisms:

- competitive auctions (as described in the Baltic model above),
- state-defined contractual frames where government establishes fixed terms and pricing formulas,
- structured negotiation where parties negotiate within regulatory methodology boundaries.

The following table compares these approaches across critical implementation dimensions, with particular attention to speed of deployment and surplus heat mobilization potential.

Dimension	Competitive Auctions	State-Defined Frame	Structured Negotiation
Price discovery	Market competition determines price through monthly bidding	Fixed formula (e.g., % of gas tariff) set by state	Bounded negotiation: ceiling = utility substitution cost, floor = supplier cost
Flexibility	None - automated merit order	Low - all projects use identical terms	High - methodology fixed, project terms negotiable
Transparency	Highest - public automated ranking	High - formula publicly known	Medium - methodology public, outcomes case-specific
Investment certainty	Low - monthly competition, no long-term guarantees	Medium-High - depends on contract standardization	Highest - multi-year negotiated contracts
Implementation speed	Estimate: 2-7 years (requires complete ecosystem)	Estimate: 6-18 months (decree drafting and approval)	Estimate: 6-18 months (adjusting existing framework)
Surplus heat mobilization rate	Slow initially, accelerates after year 2-7	Moderate - depends on formula attractiveness	Fastest - enables immediate project-by-project deployment
Legal status in Ukraine	Possible - requires legislative reform	Possible - requires ministerial decree/regulation and formulation of standards	Possible - requires ministerial decree/regulation
Prerequisites	Multiple competing suppliers, fuel markets, digital platform, 2-7 years	National decree authority, pricing formula design	Basic regulatory oversight, new methodology approval
Regulatory complexity	Highest - new legislation, enforcement capacity, digital infrastructure	Medium - formula design, monitoring compliance	Low-Medium - methodology approval, contract review
Corruption risk	Lowest - automation eliminates discretion	Low-Medium - depends on formula design and enforcement	Medium - requires transparent methodology
Best suited for	Large systems, multiple suppliers, mature markets (Year 7+)	All projects once formula established (Year 1-2)	Early single-supplier projects (Year 0.5+)
Project customization	None - standardized rules for all	None - one formula for all	High - accommodates unique technical/financial conditions
International precedent	Lithuania (Kaunas), Latvia, Estonia	Less common - some Eastern European markets	Denmark, Germany, Austria, + more

Table 5: Comparison of Heat Procurement Options

The comparative table illustrates the trade-off between transparency and speed of the models.

- Competitive auctions practically eliminate corruption through automated merit-order dispatch, but it probably requires years to establish the necessary ecosystem. During this build-out period, available industrial waste heat remains disconnected from district heating networks.
- State-defined pricing formulas can be implemented faster but will most likely struggle to accommodate diverse project economics for example heavy industry waste heat recovery differs substantially from food processing or chemical plant opportunities. A single formula risks either deterring investment or creating windfall profits.
- In structured negotiation prices are bounded by utility substitution cost (ceiling) and supplier production cost (floor), with parties negotiating specific terms e.g. through TOTEX analysis. This approach may work within an amended Ukraine's legal framework. It does however require that the regulator will permit price negotiation based on economic fundamentals rather than state-mandated formulas.

The Ukrainian conditions with single known industrial suppliers per municipality, frozen tariffs, limited utility financial capacity suggest that a “all of the above” strategy may be best:

- **1. Pursue both approaches in parallel.** Deploy structured bilateral contracts immediately for municipalities with identified industrial waste heat sources while developing auction prerequisites (BALTPOOL biomass market, legislative reform, pilot city selection) over 5-7 years. This maximizes surplus heat capture speed while building toward systematic competitive procurement.
- **2. Enable TOTEX-based price negotiation.** Regulatory authorities approve pricing methodologies establishing substitution cost ceilings and production cost floors, permitting negotiated outcomes within these bounds. Standardized contract templates reduce transaction costs while maintaining project-specific flexibility. This requires regulatory approval of methodology, not individual prices.

Early bilateral projects generate practical experience with surplus heat integration – technical specifications, operational protocols, contractual structures – that informs subsequent auction design as markets mature.

Outstanding Questions

This dual-track approach raises questions requiring further investigation such as:

- What specific regulatory provisions enable substitution cost-based negotiation while maintaining consumer protection and transparency?
- How should connection infrastructure investment be allocated and financed in capital-constrained environments?
- What institutional capacity and technical support do municipal utilities need to negotiate effectively?
- How do bilateral contracts transition when competitive auctions are introduced – grandfathered, renegotiated, or integrated into merit orders?
- Which Ukrainian municipalities might support competitive auctions within 3-5 years versus those requiring bilateral approaches long-term?
- What is the actual current potential for surplus heat utility in Ukraine?

These questions have no theoretical answers. They require pilot implementation, stakeholder engagement, and monitoring of outcomes. The priority remains capturing available surplus heat as quickly as possible

while building toward more systematic frameworks as conditions allow. International evidence supports multiple pathways; Ukrainian practice will determine what works best.

Contact information

United Nations Children's Fund Office in Ukraine
Address: 9B Mykhailo Hrushevskyi Str, 01021 Kyiv, Ukraine
Telephone: +38 044 339 93 75
Email: kyiv@unicef.org

Bibliography

Danish Energy Agency & Rambøll. (2024a). Technical support for the preparation of the new edition of the Ukrainian law on heat supply: Part I (Full version). Danish Energy Agency.

Danish Energy Agency & Rambøll. (2024b). Technical support for the harmonization of the Ukrainian regulatory framework in the field of district heating: Report II (Abridged edition). Danish Energy Agency.

Kramar, V., & Oliinyk, Y. (2022). Analiz potentsialu vykorystannia vtorynnykh teplovykh resursiv ta heotermalnoi enerhii dlia tsentralizovanoho teplopostachannia v Ukraini [Analysis of waste heat and geothermal heat potentials for district heating in Ukraine]. Agency for Renewable Energy.

Tetra Tech ES & Pacific Northwest National Laboratory. (2020). *White paper on transforming district heating in Ukraine: Assessment and recommendations* (USAID Energy Security Project). United States Agency for International Development.

Usenko, J., Savytskyi, O., & Mikhnych, V. (2025). Status of municipal heat supply in Ukraine: Challenges and solutions from the bottom up. Green Deal Ukraïna.

Online sources for information used:

Danish Board of District Heating (DBDH)
Best practice catalogue
https://dbdh.org/best-practice-catalogue/

SET HEAT
Central European District Heating studies
https://setheat.polsl.pl/resources/reports-and-deliverables/

Appendix

Appendix 1; Zhytomyr Case study